2.0 PROPOSED ACTION AND ALTERNATIVES

This section describes the types of space vehicles and missions proposed for use at or to be carried out from the SRS (Subsection 2.1.1.1, beginning on page 15), FAA licenses and approvals (Subsection 2.1.2, beginning on page 20), the SRS siting process and location (Subsections 2.1.3 and 2.1.4, beginning on pages 26 and 35), SRS operations (Subsection 2.1.5, beginning on page 36), SRS infrastructure development (Subsection 2.1.6, beginning on page 47), and alternatives (Subsection 2.2, beginning on page 79).

The proposed action and the alternatives discussed in this document were formulated as a result of public scoping that lasted from February 1995 through April 1995 (40 CFR §1501.7). The scoping process was initiated by a DOT Notice of Intent published in the *Federal Register* on February 23, 1995 (60 *FR* 10139). Public scoping meetings were held in Truth or Consequences and Las Cruces, New Mexico, on March 21 and 22, 1995. A public announcement of the scoping meetings was published in various local newspapers on each day from February 13 through February 19, 1995. Public input and comments were received through April 24, 1995. A formal report on the public scoping meetings was released by the NMOSC on June 30, 1995. A copy of the scoping report was mailed individually to each person who commented, attended a public meeting, or was included on the preliminary distribution list. Appendix A to this document contains public comments and responses. Section 1 of Appendix A contains a copy of the Notice of Intent and the NMOSC *Southwest Regional Spaceport Environmental Impact Statement Scoping Summary Report*. The scoping process continued until the initial conceptual facilities design and initial contacts with Federal and State regulatory agencies were completed in November 1995.

Subsection 2.2, beginning on page 79, identifies a range of reasonable alternatives to the proposed action as required by the CEQ regulations and DOT Order 5610.1C, *Procedures for Considering Environmental Impacts*. The alternatives considered are

- No action (preserving the status quo at the proposed SRS site)
- Development of a minimal infrastructure for the proposed SRS in order to reduce, avoid, or delay certain types of environmental impacts
- Other spaceport sites in New Mexico

- Spaceport sites outside of New Mexico

The proposed action and the alternatives of no action or developing a minimal SRS infrastructure are analyzed in detail with respect to impacts on a number of environmental attributes in Section 4.0, beginning on page 175. Other spaceport sites within and outside New Mexico were considered but eliminated from detailed study for reasons discussed in Subsection 2.2.3, beginning on page 81.

2.1 PROPOSED ACTION

The State of New Mexico proposes to construct and operate the SRS for use by private companies conducting commercial space activities and operations. The facility and its users would be licensed by the FAA/AST. The SRS would be located immediately west of WSMR between Truth or Consequences and Las Cruces in Sierra and Doña Ana counties, New Mexico (Figure 1). Existing roads, proposed roads, and facilities to be constructed are shown in Figure 2.

For the purposes of this EIS, the term "spaceport" is defined in the New Mexico Spaceport Development Act (9-15-42 to 9-15-47 NMSU 1978) as ". . . an installation and related facilities utilized for the takeoff, landing, retrieval, servicing and monitoring of vehicles capable of entering space."

Development Concept

The principal scoping documents for this project have been the USAF *Dual Use Launch Facility Grant Requirements Study for the Southwest Regional Spaceport* (NM 1995a), and the GTEC *Spaceport Task Force Feasibility Study* (NM 1995b). The overall RLV development schedule has been promulgated through a series of NASA documents relating to the commercial space development policy and initiation of the flight verification stage of the development of the

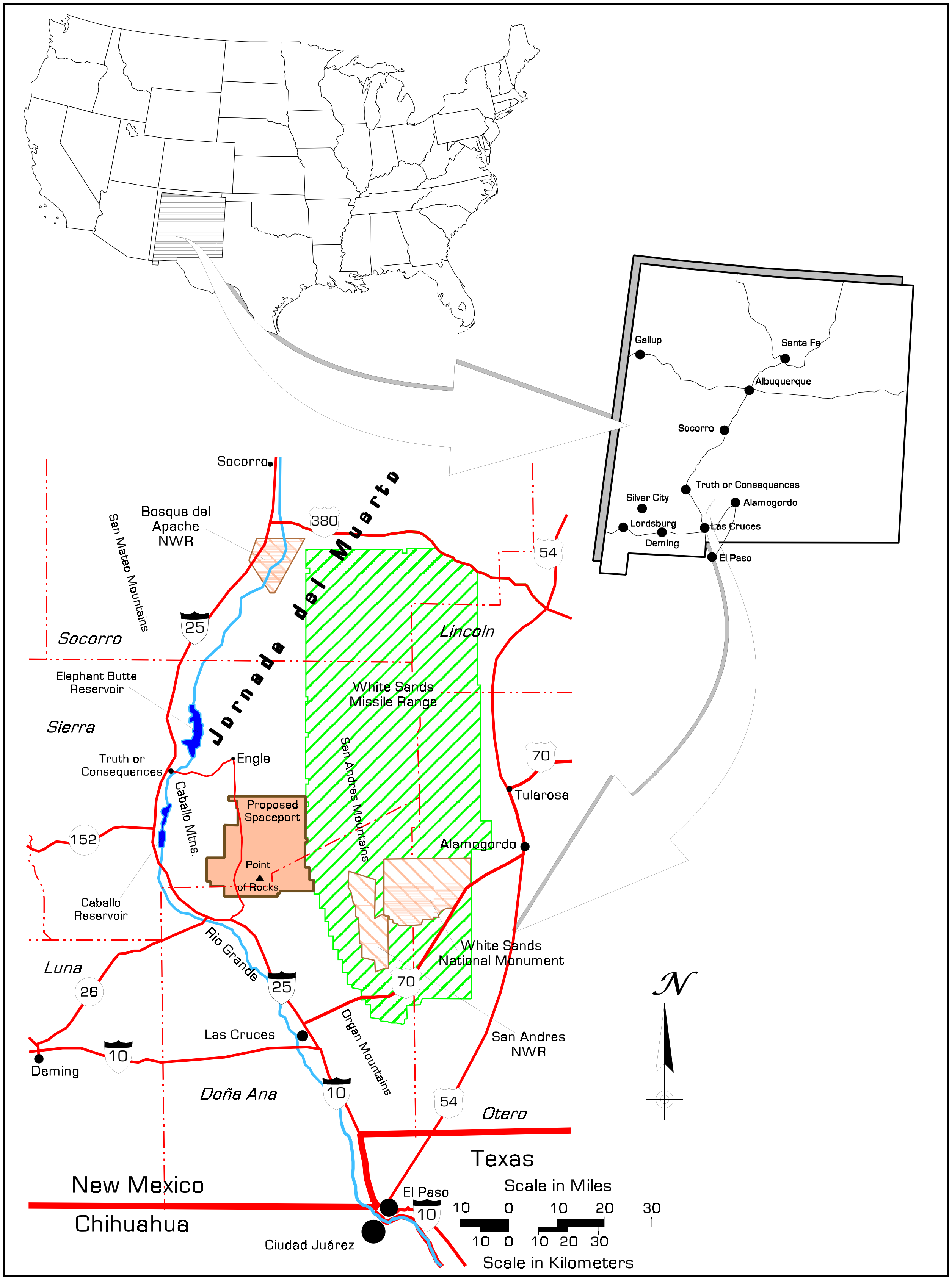

Figure 1. Spaceport Regional Location Map

Figure 2. Project Facilities

advanced technology demonstrator vehicle, Experimental Design No. 33 (X-33). Using these studies and documents as guidelines for spaceport facilities, NMOSC established a concept that would provide an initial SRS operational capability in mid-2001 and accommodate full-scale commercial RLV operations in 2002. For purposes of this document, the resultant conceptual facilities design layout is the proposed action. A synopsis of the expected schedule used to perform the analyses of the conceptual layout for environmental impacts is discussed in this subsection.

The first milestone is completion of the FAA Launch Site Operator License requirements including this Environmental Impact Statement and concurrent safety and risk studies. This milestone is projected for completion in mid-1997. Achievement of this milestone would allow New Mexico to make binding commitments with prospective SRS Launch Operators.

The next part of the SRS development plan would not be initiated until positive responses concerning use of the SRS are obtained from the aerospace industry, and the Lockheed-Martin/NASA X-33 program has exhibited satisfactory progress in solving the technical issues associated with new single-stage-to-orbit (SSTO) technology. The action initiating this portion of the SRS development cycle would be authorization by the New Mexico Legislature for

- acquisition of public and private land within the SRS boundaries
- completion of formal engineering investigations and design of the facilities and infrastructure

The conceptual schedule used in this EIS projects the initial date of this activity as early 1998.

The third part of the SRS development plan would begin with legislative authorization for the New Mexico State Land Office (NMSLO) to start an appropriate land exchange with the BLM for acquisition of Federal land. The State agency responsible for SRS development also would initiate acquisition of private land. Achievement of this milestone would culminate with the start of construction. Construction of the main access road would be the first project. The conceptual schedule used in this EIS projects completion of infrastructure initial design activity and actual start of construction to be the first part of 1999. Design activities are expected to continue through the majority of the construction period. Construction is programmed to continue through mid-2001.

Key elements in the design of facilities and infrastructure would be selection of the proposed action or minimal infrastructure alternative. A commitment to either alternative could not be made until successful completion of the flight demonstration phase of the X-33 program, and a programmatic decision made at the national level to continue with development of the commercial RLV. These key decisions are conceptually scheduled for late 1999–early 2000. Other key actions not possible until this time are

- selection of electrical power contractor and applicable 40-kV power line access route
- selection of the natural gas contractor and applicable pipeline route
- decision on construction of cryogenics plant with the integral decision on the configuration of the water distribution system

Personnel staffing for administration and operations would begin in 1998 and be completed by mid-2001. Operational training for NMOSC personnel would begin in mid-2000. Manning of launch operator contractor facilities by the contractor's personnel would start in 2001. Achievement of this milestone would be initial operational capability by the year 2002.

After commercial RLV operations start in 2002, it is projected that commercial RLV operations would increase linearly until the GTEC forecast maximum market segment of thirty-five annual launches were achieved in 2015 (NM 1995b).

Land Exchange Actions

As noted in the discussion of the developmental concept, the actions to initiate a land exchange between New Mexico and the BLM will not be made until after the Launch Site Operator License has been approved by the FAA. The land exchange process, discussed in detail in Section 2.1.6.1, beginning on page 49, will require additional NEPA compliance and National Historic Preservation Act (NHPA) clearances. This EIS is being written to allow BLM to utilize it in performing the required environmental reviews for the land exchange (40 CFR §1506.3) if desired. The land exchange also will require NHPA Section 106 consultations, including a negotiated Programmatic Memorandum of Agreement (PMOA), among the BLM, the NMSLO, the State Historic Preservation Officer (SHPO), and the Advisory Council on Historic Preservation. The PMOA would provide for the preservation and protection by the State of New Mexico of cultural resource properties within the proposed SRS. By agreement between the SHPO and the Advisory Council, the Section 106 consultations and the PMOA for the land exchange action would serve the same functions for the FAA licensing action. Accordingly, the SHPO and the New Mexico Historic Preservation Division have agreed that the submission and approval of the final report on the SRS cultural resource surveys, and the inclusion of appropriate recommended mitigation measures, would satisfy the NEPA and NHPA consultation requirements for the Launch Site Operator License.

2.1.1 INTRODUCTION

This section addresses the types of launch vehicles and space missions proposed for the SRS. The section also discusses what is not proposed for the SRS to help clarify the scope of operations.

2.1.1.1 Types of Space Vehicles Proposed for the SRS

Single-Stage-to-Orbit Reusable Launch Vehicles

The SRS is intended to support the launch and recovery of fully reusable space vehicles or RLVs. These also are referred to as SSTO vehicles. Expendable launch vehicles (ELVs) would not be used. The SRS would provide support for a full range of mission profiles including satellite launches and recoveries, scientific research, and space station support using RLVs.

Until the development of the Space Transportation System, better known as the Space Shuttle, essentially all space launches were conducted using ELVs. Most ELVs are multistage vehicles that have two or more sets of engines and fuel tanks. Each jettisoned stage falls away as the next stage ignites. The jettisoned stages follow ballistic trajectories to earth impact. Two-, three-, and even four-stage rockets are common. Many current launch vehicles use “strap-on” solid rocket motors that provide supplemental thrust during the initial phase of the flight but burn out and drop off before the central core stage is exhausted.

With few exceptions, orbital ELV flights are launched over water to minimize risks to humans from jettisoned stages. Malfunctions usually result in the loss of the vehicle and payload. ELVs in use today cannot meet the stringent safety requirements for launch over land except under carefully controlled conditions. An RLV would be designed to land safely and would have safe downrange abort capability. Problems such as failure of one or more engines could be solved by returning to the launch site, by landing at an alternate downrange site, or by entering an unplanned orbit. The design of the RLV is not sufficiently advanced to allow an analysis of specific locations and configurations of potential downrange emergency landing sites. However, potential sites are existing NASA Kennedy Space Center and USAF Cape Canaveral Air Station space launch and landing facilities in Florida. These facilities have existing NEPA documentation evaluating space vehicle operations. Use of any other potential emergency landing site may require the preparation of appropriate environmental documentation.

The Space Transportation System is a partially reusable space vehicle. Although the Space Shuttles are fully reusable, major propulsion components (the solid rocket boosters and external fuel tank) are jettisoned as the flight progresses. The solid rocket boosters drop by parachute into the ocean, are recovered and refurbished, reloaded with fuel, and reused. Liquid fuel for the main engines is carried in the external tank that is jettisoned just before the vehicle achieves orbit. It is directed to a controlled reentry and not recovered.

If the stated NASA RLV program objectives are achieved, a fully reusable launch system as proposed for the SRS would greatly reduce the cost of putting payloads into orbit. Technology is just now at the point where fully reusable designs are becoming feasible. A fully reusable launcher is likely to be an SSTO vehicle. An SSTO vehicle has only one set of engines, and no components are jettisoned during flight.

X-33 Vehicle

The X-33 program is a NASA project intended to demonstrate that the technology required for a true SSTO vehicle is feasible. Additional elements of the program are airplane-like rapid turn-around between missions and low-cost operation. Program participants are required to fund a significant portion of their own program. The X-33 program solicited preliminary vehicle designs from the aerospace community. The design developed by the Lockheed Martin Corporation team was selected for full-scale development. Although the X-33 is not required to be an orbital vehicle, it is expected that a true orbital design variant will be derived from the program. Many details have yet to be finalized, but certain core requirements are evident.

- The vehicle, including its engines, must be very light for the amount of fuel it would carry. This would dictate the extensive use of “high technology” materials—composites and high-strength, low-weight alloys.
- Liquid hydrogen/liquid oxygen engine would be used to meet the combined requirements for thrust and reliability. The only combustion product of significant quantity from the engines would be water vapor. Toxic hypergolic fuels would not be used for thrusters.
- All components must be highly reliable.

- Ground operations must be simplified to the point that large ground crews such as those needed in the Space Shuttle program would not be required.
- A durable system for protection from the high temperatures generated by hypersonic travel in the atmosphere, including reentry, would be required.

As currently envisioned, the commercial version of the RLV would be launched vertically, achieve orbit, perform its orbital mission, reenter the atmosphere, and land. The vehicle would not have an on-board crew. It would be operated with autonomous, on-board, state-of-the-art guidance, navigation, and control systems. The system also could be operated remotely from the ground.

It is expected that a commercial version of the RLV and other SSTO vehicles would operate much like aircraft. The vehicle would be serviced and prepared for a mission. It would fly the mission, land, and begin the cycle for the next mission. Programmatic design criteria from the NASA Cooperative Agreement Notice 8-3, *X-33 Phase II: Design and Demonstration,* issued April 1996 illustrate the basis for this conclusion (NASA 1996a). The NASA criteria for the X-33 vehicle are that the system would demonstrate key aircraft operational attributes in terms of operability, functionality, reusability, safe abort, and affordability. All of these demonstrable attributes are required to be directly traceable and scalable to the full-scale RLV vehicle.

The RLV that would be operated from the SRS would be a fully reusable, highly reliable, operationally safe vehicle with state-of-the-art flight systems. All of the components of the RLV derived from the X-33 design would be capable of a 100-mission minimum operational life with 20 flights between depot maintenance, on a two-week flight-reprocessing schedule. The current shuttle system averages approximately 10 direct labor hours per pound of vehicle structure and requires a ground maintenance effort of several hundred personnel. A flight-reprocessing time of several months is normal. The anticipated RLV maintenance requirements would be an average of 0.5 direct labor hour per pound of vehicle structure and require a maximum of 50 ground maintenance personnel (NASA 1996a).

The critical aircraft operation attributes that would be demonstrated by the X-33 development program are reusability and safe abort capability. In order to attain the desired flight-reprocessing time, the vehicle must have the capability to terminate each flight without damage to the systems. This attribute would include a fully controlled "soft landing" even under emergency conditions, such as propulsion failures and primary system flight control and guidance failures.

Completely unlike the current solid propellant booster system technology used by many operating space vehicle systems, the liquid propellant engine systems of the X-33 and RLV would be controllable in the same manner as aircraft engines. In the majority of ELVs and other space vehicles, after the solid propellant engines are ignited for liftoff, the system cannot be shut down. ELV flight anomalies requiring vehicle destruction for safety purposes result in highly spectacular pyrotechnic displays of burning solid propellant fuel. In the event of most anomalies, the multi-engine design of the RLV would allow the flight control and guidance system to fly the vehicle back to the SRS or other site for a controlled, safe landing. If the RLV on-board sensors detect a partial propulsion failure, the affected engine fuel-supply valves could be closed and that engine shut down.

2.1.1.2 Types of Space Missions Proposed for the SRS

The types of space missions currently proposed for the SRS include

- Payload missions—orbital or suborbital launches in which the payload returns with the vehicle. These could include scientific experiments, materials processing, and pharmaceutical manufacturing. Pre- and postlaunch processing of the vehicle and payload would be considered part of the mission.
- Launcher missions—payload is left in orbit. These could include deployment of communications and scientific satellites. Prelaunch processing of the vehicle and payload would be considered part of the mission.
- Landing missions—reentry and landing of a space vehicle from orbit.
- Recovery missions—recovery of payloads and payload processing. These would include retrieval of payloads left in orbit by earlier missions.

2.1.1.3 What the SRS Is Not

The SRS would not be a launch facility for vehicles designed to jettison components or to use solid-fuel engines. Proposed as an exclusively commercial facility, the SRS would not be a military research and development or operational testing of missiles facility. These missions are being performed at various facilities such as Cape Canaveral, Florida; Vandenberg Air Force Base, California; Edwards Air Force Base, California; and White Sands Missile Range, New Mexico. These installations will continue to perform these types of missions. (Payloads may be launched for NASA or for military services, however.) The initial RLV developmental vehicles—the SSTO advanced technology demonstrator vehicle (X-33)—will be developed and tested at one or more of these facilities. Current models of manned space vehicles and future models of ELVs also would not be suitable for launch or recovery at the proposed SRS.

The SRS would not be a massive military-industrial complex. The substantial infrastructure that has been built into the existing space vehicle operating facilities is necessary to ensure public safety for conventional missile and rocket test operations, as well as performing the extensive maintenance required by current space vehicle technology. This support network of personnel and equipment would not be required for full-scale RLV operations at the SRS. Full-scale RLV operations at the SRS would require only approximately 500 personnel. It would not require the extensive infrastructure or staffing levels of current space and missile test installations.

As a result of using space vehicles with operability, maintainability, and flight safety reliability, the SRS would not be a secluded, closed facility like the current space flight or weapons testing facilities. Although some degree of control would be required over public use of the area, the area closed to current multiple-use activities would be minimal. Approximately 27 sections (17,280 acres)—approximately 7%—of the 387-section (247,398-acre) total area would be reserved on a full-time basis for SRS activities.

The proposed SRS would not be an extension of WSMR. As the holder of the FAA/AST Site Operator License, NMOSC (or the appropriately constituted agency of the State of New Mexico) would have the responsibility for the management and functional operation of the SRS. However, during the initial phases of operation, it is anticipated WSMR would provide facilities for support of vehicle tracking, command, control, communications, and other services needed to conduct safe flight operations.

2.1.2 FAA LICENSES AND APPROVALS

Operation of the proposed SRS and launches by individual commercial launch operators would be governed by various licenses, approvals, and other regulatory requirements imposed by the FAA/AST. This section discusses statutory and regulatory requirements pertaining to SRS operations and to individual launch operators. It also discusses FAA requirements pertaining to construction and operation of the proposed airfield.

The FAA/AST office has three different but closely interrelated licensing and registration requirements that affect SRS operations

- Launch Site Operator License to operate a commercial launch site (Subsection 2.1.2.1)
- Launch (Operator's) License to launch an unmanned (space) vehicle (Subsection 2.1.2.2, beginning on page 22)
- Registration of objects launched into outer space (Subsection 2.1.2.3, beginning on page 24)

In addition to FAA/AST requirements, there are numerous FAA certifications, standards, and guidance documents pertaining to such topics as noise, airspace, airfield construction and operation, and operation of unmanned rockets. The FAA/AST has the authority necessary to enforce compliance by the SRS and individual launch operators with all of these requirements. Under the CSLA, requirements of the laws of the United States applicable to the operation of a launch site are requirements for a license, unless otherwise provided by the FAA.

2.1.2.1 Launch Site Operator License

The issuance of a Launch Site Operator License is based on demonstrating to the FAA/AST that operation of the launch site does not jeopardize the safety of the public and property both on and off the site. Under the OCST draft guidelines for obtaining a Launch Site Operator License (DOT 1994), the safety responsibility of the SRS as site operator is distinguished from that of the private launch operator. The CSLA defines "launch site" as "the location on Earth from which a launch takes place . . . and the necessary facilities at the site" (49 U.S.C. §70102(6)). The SRS would be responsible for protecting the public and site tenants from routine operational hazards that result from operations of the site. By contrast, the launch operator would have responsibility under its own FAA/AST license for hazards associated with any particular launch. The requirements for this separate license are discussed in Subsection 2.1.2.2, beginning on page 22. The site operator would have to assure adequate safety equipment, procedures, and personnel to operate its launch site safely as well as define appropriate corridors for vehicles proposed for launch from its site. Operational safety is discussed in Subsection 2.1.5.3, beginning on page 40. The SRS would have the ultimate responsibility for providing support for vehicle tracking, command, control, communications, and other services needed to conduct a safe launch unless provided by the launch operator.

The Launch Site Operator License application, which would be filed with the FAA/AST by the NMOSC, would contain information needed to demonstrate that the SRS was properly located and capable of operating in a manner that would not jeopardize public health and safety, the safety of property, or U.S. national security and foreign policy interests. The SRS safety demonstration would be accomplished through

- Performance of a hazard analysis that would identify foreseeable hazards, assess the probability of their occurrence, identify adverse consequences and determine the probability of their occurrence, and assess mitigation measures designed to control risks.
- Preparation of a Launch Site Safety Operations Document (LSSOD) containing a detailed discussion of specific methods to be used in addressing safety issues associated with commercial launch site operations.

The proposed SRS license application would contain

- Information about the license applicant (the NMOSC).
- Information about the proposed site (e.g., location, size, geographic characteristics, flight paths, launch and landing areas, and meteorological data).
- Information on planned day-to-day operations including prelaunch activities, landing operations, and activities during nonoperational periods.
- An analysis of hazards that SRS operations might pose to site workers, site visitors, people off the site but in close proximity, and populations along flight paths. Mitigation measures to either eliminate or reduce potential hazards would be described in detail.
- An LSSOD that would govern how the SRS would be operated to ensure safety of the public and property. The LSSOD would contain information on safety policies and procedures, safety organization, personnel qualifications, facility layout, facility access and security, emergency response plans, accident investigation plans, and other topics critical to SRS site safety requirements and procedures.
- Flight safety analyses.
- Additional material supporting the application in terms of occupational health and safety, standard operating procedures, and risk management analyses.

2.1.2.2 Launch License

A launch license is required for any launch from U.S. territory. The launch license authorizes the launch to be conducted in order to achieve certain mission objectives. One license could cover a program of launches by the same launch operator within an approved range of parameters so long as the same safety resources support the entire series (53 *FR* at 11007).

Each individual tenant or user of the SRS proposing to launch a vehicle would have to obtain a Launch License under FAA/AST regulations in 14 CFR Part 415. These regulations constitute the procedural framework for reviewing and authorizing all proposed commercial space launches of vehicles. 14 CFR Part 413 also applies and describes the different reviews conducted by FAA/AST—including review of payloads not licensed by other Federal agencies—in licensing launches. The licensing regulations are intended to provide a basis for determining whether commercial launch companies are capable of operating safely and responsibly. The general operating safety requirements that would be imposed by the SRS on individual launch operators are discussed in Subsection 2.1.5.3, beginning on page 40.

Under the regulations, a launch operator using the SRS would have several options. The operator could conduct all of its own safety operations, it could rely on a government facility and services to support safety operations, or it could combine its own safety operations with those of a launch site facility operator. It is proposed that safety procedures be implemented cooperatively by both the SRS and the private launch operators (Subsection 2.1.5.3, beginning on page 40).

The time period for which a launch license is valid is specified in the license. Once the FAA/AST provides both mission and safety approvals, those approvals remain in effect ". . . as long as the information submitted as part of the review and other matters of decisional significance to (the FAA/AST) remain accurate and valid" [14 CFR §415.7(b)].

Requests for licenses authorizing the operation of a launch site are reviewed on the basis of the applicant's capability to operate a facility where safe operations are conducted on a continuing basis as support for launching certain classes of launch vehicles [14 CFR §411.3(b)].

Evaluation of license requests for unmanned launches involves a Safety Review and a Mission Review (14 CFR §411.3).

These two reviews are designed to determine the efficacy of the proposed operations and significant issues affecting U.S. national security interests, foreign policy interests, or international obligations of the U.S. associated with the proposed launch respectively.

The Safety Review referenced in 14 CFR Part 415, Subpart B, would focus on a number of safety elements involved in a proposed launch including the proposed site, procedures, personnel, and equipment. A hazard analysis also would be conducted for any activity solely under control of the launch operator and would include mitigation measures (Subsection 2.1.5.3, beginning on page 40).

The Mission Review procedure outlined in 14 CFR Part 415, Subpart C, would cover all aspects of the proposed launch except for safety operations covered by the Safety Review. It may entail description of the launch vehicle, flight plan, and nature and ownership of the payload. Mission approval would be granted unless the proposed launch posed a threat to U.S. national security or foreign policy interests or if launch of the payload would jeopardize public health and safety or safety of property.

The FAA/AST approves payloads by making a determination in certain circumstances. If the launch operator is proposing to launch a payload not subject to Federal Communications Commission or National Oceanic and Atmospheric Administration regulation, the operator must provide an assessment of safety issues, and a description of the proposed orbit, including altitude and inclination (53 *FR* at 11012).

Launch licenses are subject to terms and conditions that the FAA/AST considers necessary to protect public health and safety, the safety of property, and the national security and foreign policy interests of the United States. Along with other conditions, a launch license is conditional upon the licensee obtaining liability insurance, or otherwise demonstrating financial responsibility to cover third-party claims for death, injury, property damage, or loss resulting from an activity carried out under the launch license up to a ceiling of $500 million (49 U.S.C. §70112). AST determines the required level of insurance based upon its determination of the maximum probable loss from claims by third parties that would result from licensed launch activities. A launch licensee also must obtain insurance to compensate the U.S. Government for damage or loss to its property as a result of licensed activities, up to a ceiling of $100 million. The office's determination of the requisite insurance level is also based on maximum probable loss.

2.1.2.3 Registration of Objects

An additional requirement of the regulations pertains to the registration of space objects (14 CFR §415.10). Each launch operator holding a license must register all objects placed in space unless owned by a foreign entity. This is in accordance with Article IV of the 1975 Convention on Registration of Objects Launched into Outer Space.

2.1.2.4 FAA Requirements Pertaining to Proposed Airfield and Aircraft

The SRS conceptual design includes an airfield for logistical support and/or use for landing RLVs (Subsection 2.1.6.4, beginning on page 62). For purposes of this document, this facility is called an airfield because there would be no scheduled passenger traffic. Several FAA regulatory requirements govern the operation of aircraft and the construction and operation of airports; however, very few of these requirements expressly apply to construction and operation of the airfield proposed as part of the SRS facility. The principal requirement that applies to the proposed airfield is in 14 CFR Part 157 that mandates written notice be given to the FAA for any proposal to

- Construct or otherwise establish a new airport or activate an airport.
- Construct, realign, alter, or activate any runway or other aircraft landing or takeoff area of an airport.

The regulations define "airport" to include, among other things, any airport, heliport, gliderport, or other aircraft landing or takeoff area. Thus, the notice requirement applies to both the proposed airfield and helicopter landing area. The notice must be submitted on FAA Form 7480-1 to either the FAA District Field Office (Albuquerque) or the FAA Regional Office (Fort Worth, Texas). The notice must contain information on the purpose of the airport (or airfield), obstructions, noise considerations, landing area data, and operational data. Following filing of the notice, the FAA conducts an aeronautical study and issue a determination to the proponent (in this case, NMOSC) and other interested persons. The FAA determination can be

- no objection
- conditional (with the conditions specified)
- objectionable

Each determination has a "void date" that can be extended.

In addition to the notice requirement, various requirements apply to aircraft and aircraft operators that would use the proposed airfield. Examples are

- *Type Certificates (14 CFR Part 21, Subpart B).* These FAA regulations contain procedural requirements for issuance of "type certificates" for aircraft, including large transport-type aircraft (e.g., modified Boeing 747s), that would ferry space vehicle components to the SRS.
- *Airworthiness Standards (14 CFR Part 25).* Airworthiness standards for transport-category aircraft apply to such elements as flight performance, flight loads (structure), design and construction,

power plant, equipment, and operating limitations. Compliance with Part 25 standards is required to obtain a type certificate under Part 21.

- *Noise Standards (14 CFR Part 36)*. These standards apply to the issuance of type certificates under Part 21 and include requirements for noise measurement and evaluation for transport-category large aircraft.
- *Air Traffic and General Operating Rules (14 CFR Part 91)*. These rules establish flight rules, equipment and instrument certifications, maintenance, and operating noise limits for all aircraft operating within the U.S.

2.1.2.5 Other Federal, New Mexico, and Local Permits and Requirements

Environmental laws, regulations, and permits applicable, or potentially applicable, to the construction and operation of the proposed SRS are summarized in Table 56, beginning on page 316, in Section 6. The environmental parameters addressed in Table 56 are cultural resources; air quality; water quality; hazardous waste; noise; wildlife, plant, and habitat protection; land use; water rights; spill control; and safety and health. The proposed SRS would comply with all of these requirements where they apply. Although there are few local environmental protection requirement, Sierra and Doña Ana counties and affected communities would be consulted when appropriate.

2.1.3 SRS SITING PROCESS

The technical process for determining the location of the proposed SRS was accomplished through three separate, distinct programs. The first two were grant programs funded by NASA and the USAF. The third was a direct responsibility by the U.S. Army to WSMR.

The first program was a technical feasibility study funded by NASA under a grant authorized in 1992. The second was funded by the USAF under a grant authorized in 1993. These two programs were introduced in Subsection 1.1.2, beginning on page 4. The combined processes used by the two programs are discussed in Appendix C.

The third process was conducted by WSMR with funding from the U.S. Army. The purpose was to participate in commercial space development studies being conducted in the Southwest. The results were an environmental study published as the WSMR *Environmental Siting Analysis for the Southwest Regional*

Spaceport Program in March 1993. These results later were incorporated into NMSU (1995). The WSMR report is cited throughout this document as WSMR (1993).

The NASA grant feasibility study program originated as a study to determine the feasibility of recovery of commercial space vehicles on land. The program was expanded to include the commercial launching of space vehicles, including vehicles using the emerging single-stage-to-orbit reusable launch vehicle concept. As noted in Subsection 1.1.2, beginning on page 4, the NASA grant program culminated in the publication of the *Southwest Regional Spaceport Technical Feasibility Report and Strategic Development Plan* in March 1995. NMSU, as grant administrator, was the publisher of this final report. It is cited throughout this document as NMSU (1995).

The feasibility study that led directly to the proposed development of the SRS was the study conducted under the USAF Dual Use Launch Facility Grant Program. The principal purpose of the USAF grant program was to support analyses necessary to permit phased development and operation of a spaceport usable by both military and commercial operations. In 1993, the initial grant was awarded to the State of New Mexico based on a proposal submitted by the Office of the Lieutenant Governor. The grant and inclusive study was the responsibility of the newly formed New Mexico Office for Space Commercialization (NMOSC). By the time the *Dual Use Launch Facility Grant Requirements Study for the Southwest Regional Spaceport* was published in April 1995, the New Mexico Economic Development Department (NMEDD) had become the cognizant administrative authority for the spaceport. NMOSC, now under NMEDD, was still responsible for the day-to-day management of the SRS development including completion of the Grant I study. The USAF Grant I report is cited throughout this document as NM (1995a).

Both the USAF Grant I and the NASA feasibility study teams had representatives from NMSU and WSMR as team members, which fostered a free exchange of information and ideas between the groups. The interrelationships between the programs are shown in Figure 3. The general results of these siting studies are summarized in this section and discussed in greater detail in Appendix C.

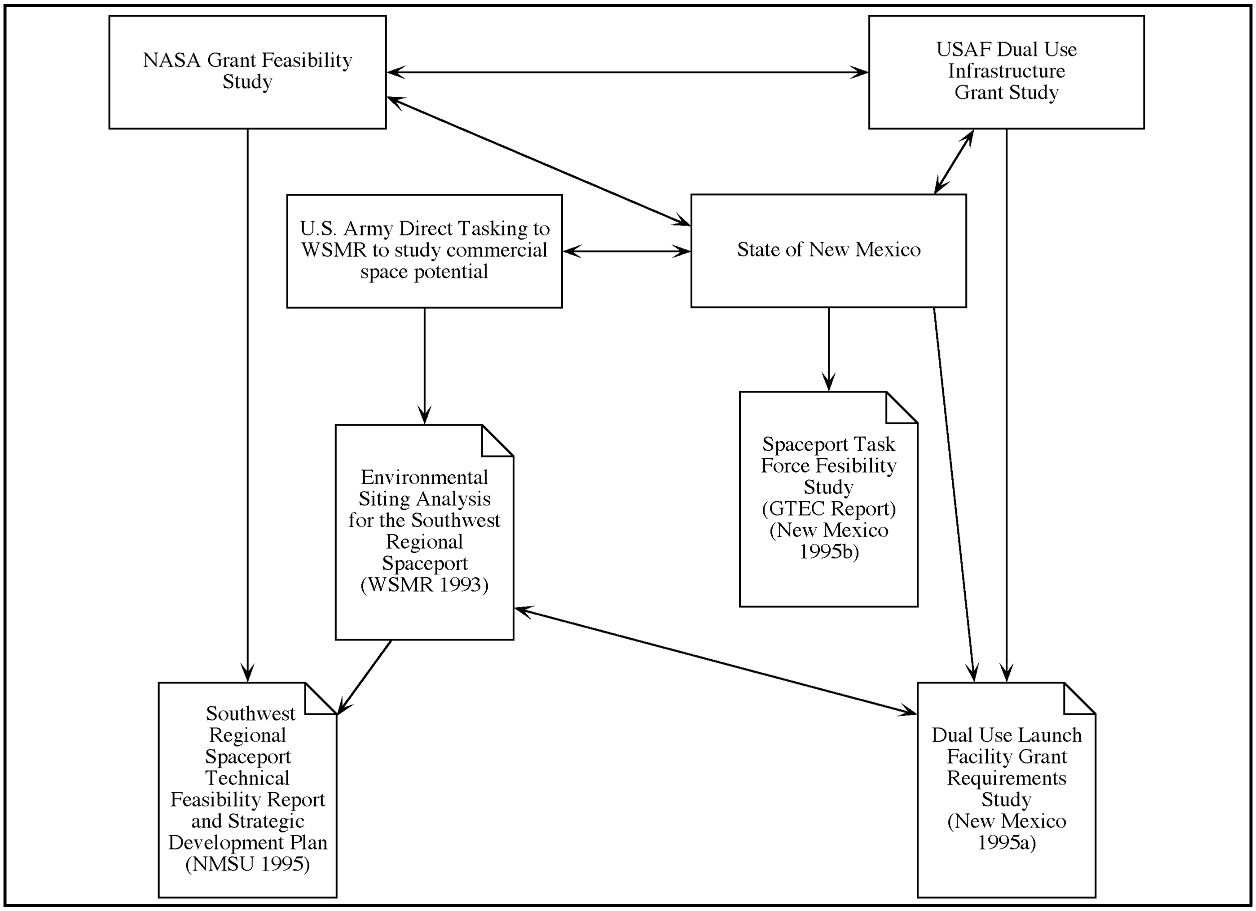

Figure 3. Relationship of Siting Studies for the Proposed SRS

Following the February 1995 legislative approval of the SRS, the administration of Governor Johnson commissioned a separate technical review of the SRS. The report of that commission was published in June 1995 as the Governor's Technical Excellence Committee (GTEC) *Spaceport Task Force Feasibility Study*. This feasibility study drew heavily on the information published in the preceding three studies. This study is cited throughout this document as NM (1995b).

Initially, the NMSU (1995) criteria considered for a spaceport location were ballistic reentry risk, population density, and orbital access. The criteria for determining reentry risk were the same as those the FAA/AST had published in association with the Commercial Experiment Transporter (COMET) Reentry Vehicle System. Those criteria appeared in the *Federal Register* on March 24, 1992 (57 *FR* at 10213 to 10216). The COMET proposal involved a landing site area defined as an ellipse with a major (long) axis of 29.7 miles and a minor (short) axis of 9.9 miles, with a 100-mile buffer around this ellipse.

For convenience, the study used a circle with a diameter of 230 miles. To achieve the required acceptable risk levels, the maximum permissible average population density per square mile within this landing site was established for the NASA study as 10 people or less. The maximum permissible population density per square mile within the larger screening circle was established at approximately 15,000 people.

NMSU (1995) initially examined candidate spaceport locations in southern California, southern Nevada, Arizona, New Mexico, western Texas, and northern Mexico. Ten sites were selected for further investigation. These sites were in the vicinities of

- Las Vegas, NV
- Kingman, AZ
- Winslow, AZ
- Greenlee County, AZ
- White Sands Missile Range, NM
- Roswell, NM
- Tucumcari, NM
- Carlsbad, NM
- Van Horn, TX
- Northern Chihuahua, Mexico

Additional location constraints and requirements that emerged from this study included land use and accessibility, orbital insertion physics, existing infrastructure, topography and soil characteristics, access to air space, extent of landing zones, land ownership, meteorological conditions, and general environmental considerations. These criteria and secondary criteria are discussed in detail in NMSU (1995) and summarized in Appendix C.

The objective of NMSU (1995) was not to select a specific site but to determine the technical and economic feasibility of a commercial, inland spaceport in the region. The investigation of the sites listed previously showed that the ten sites studied were all technically acceptable to varying degrees. However, the southern New Mexico area adjacent to WSMR emerged from NMSU (1995) as the most viable location for a regional spaceport. This location met the NASA study technical siting requirements and complied with broad-based environmental and public safety constraints better than any of the sites briefly examined. WSMR (1993) and NM (1995a) focused initially on this location as a result of the findings of NMSU (1995). Work is still in progress under separately funded grants to further refine risk and flight safety analyses.

In WSMR (1993), a literature search using over 90 published reports concerning archaeology, geology, biology, flight operations, noise, socioeconomics, and other environmental considerations was performed to consider potential environmentally related siting limitations of four representative sites located on the western flank of WSMR. These sites are shown in Figure 4 as CS-A through D. Siting criteria used to select these four sites are discussed in Appendix C.

The study for NM (1995a) screened ten potential sites for the SRS west of WSMR. These sites were in the same general area as the four sites previously examined in WSMR (1993) and are shown in Figure 4 as Sites 1 through 10.

NM (1995a) used 19 environmental and engineering criteria. The results of combining and summarizing the evaluation criteria of WSMR (1993) and NM (1995a) are shown in Table 1. A total of 24 potential locations were evaluated by the NASA, WSMR, and USAF studies.

Figure 4. Feasibility Study Site Selection Candidate Locations

Table 1. NMOSC/WSMR Site Screening Criteria Leading to Selection of Proposed SRS Sites [1]

Candidate Site Characteristics	S-1/CS-A	S-2	S-3	S-4	S-5	S-6	S-7/CS-B	S-8/CS-C	S-9	S-10/CS-D
Existing infrastructure	Adequate	Marginal	Good	Good	Good	Adequate	Adequate	Poor	Adequate	Marginal
Proximity to population center	Good	Good	Adequate	Adequate	Adequate	Adequate	Marginal	Marginal	Marginal	Marginal
Access to typical launch/ recovery azimuths	Adequate	Adequate	Adequate	Good	Good	Good	Good	Adequate	Poor	Poor
Minimal interference with WSMR operations	Adequate	Adequate	Good	Good	Good	Good	Adequate	Adequate	Marginal	Marginal
Departure buffer zone	Marginal	Marginal	Adequate	Adequate	Good	Good	Adequate	Adequate	Adequate	Marginal
Ecological compatibility	Marginal/ Big horn sheep	2	2	2	2	2	Adequate	Adequate	2	Marginal
Cultural resources compatibility	Poor	2	2	2	2	2	Marginal	Marginal	2	Marginal
Air quality compatibility	Poor	Poor	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Poor	Adequate
Water quality compatibility	Poor	Poor	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate
Noise pollution compatibility	Poor	Poor	Adequate	Adequate	Adequate	Adequate	Adequate	Poor/WSA	Poor	Marginal
RFR/EMI potential	Marginal	Marginal	Adequate	Adequate	Adequate	Adequate	Marginal	Adequate	Marginal	Adequate

Note 1: Sites investigated in NM (1995a) are keyed to map locations on Figure 4 as numbers S-1 through S-10. Sites evaluated by WSMR (1993) are numbered CS-A through CS-D. Sites S-1 through S-4 are within the proposed SRS boundaries.

Note 2: WSMR (1993) included a non-NEPA environmental evaluation of four sites from representative locations near the western WSMR boundary. This evaluation was based on a literature review and consultation. The NM (1995a) evaluation team performed a physical site evaluation for general technical and environmental considerations with the expectation that a detailed, formal environmental evaluation would be made on the most technically suitable site(s).

WSA — Wilderness Study Area

NMOSC used the results of NM (1995a) to identify the proposed SRS site described in Subsection 2.1.4, beginning on page 35.

Orbital Access

Basic physics imposes certain technical requirements on the process of launching a vehicle into orbit. The most fundamental requirement is that the vehicle attain orbital speed, which is about 17,500 miles per hour for low earth orbit. Low-earth refers to orbits up to several hundred miles above ground. A low-earth orbit is completed in about 90 minutes. For higher orbits, the orbital speed is actually lower, not higher. The plane of an orbit must always pass through the center of the earth. An equatorial orbit is an orbit in the plane of the equator.

As the earth rotates on its axis, its surface rotates west to east. At the equator, the rotational speed is approximately 1,000 miles per hour. It is reduced at higher latitudes until it reaches zero at the poles. At the latitude of the proposed SRS, the rotational speed of the surface of the earth is 870 miles per hour. Thus, a space vehicle launched on a due easterly course from the SRS would have 870 miles per hour of the 17,500 miles per hour required to reach orbit. For this reason, nearly all orbital launches, except for polar orbits, are conducted to the east, and due-east launches receive the maximum boost. An easterly launch from any point not on the equator results in an inclined orbit. The plane of the orbit is tilted from the equator by a number of degrees equal to the latitude of the launch site. To achieve an equatorial orbit from a launch site not on the equator, a vehicle must fly a trajectory that requires more fuel than a due-east launch. A further complication is that orbits can be elliptical. The vehicle altitude varies from the perigee (the point of closest approach) to the apogee (the highest point). Most satellites are placed in circular or near-circular orbits. All other factors being equal, a launch from a high ground elevation is an advantage primarily because less fuel is required to overcome air resistance in the thinner air.

A geosynchronous orbit (also called a geostationary orbit) is a circular equatorial orbit at an altitude in which the vehicle completes one orbit in exactly one day and so remains above a fixed point on the surface. The altitude for a geosynchronous orbit is about 22,300 miles above the surface. Many communication and weather satellites are placed in geosynchronous orbits. A polar orbit is an orbit that passes over the poles. Polar orbits are often desirable for earth observing satellites such as Landsat because these orbits overfly all the earth's surface. Figure 5 is a depiction of an equatorial orbit, an inclined orbit, and a polar orbit.

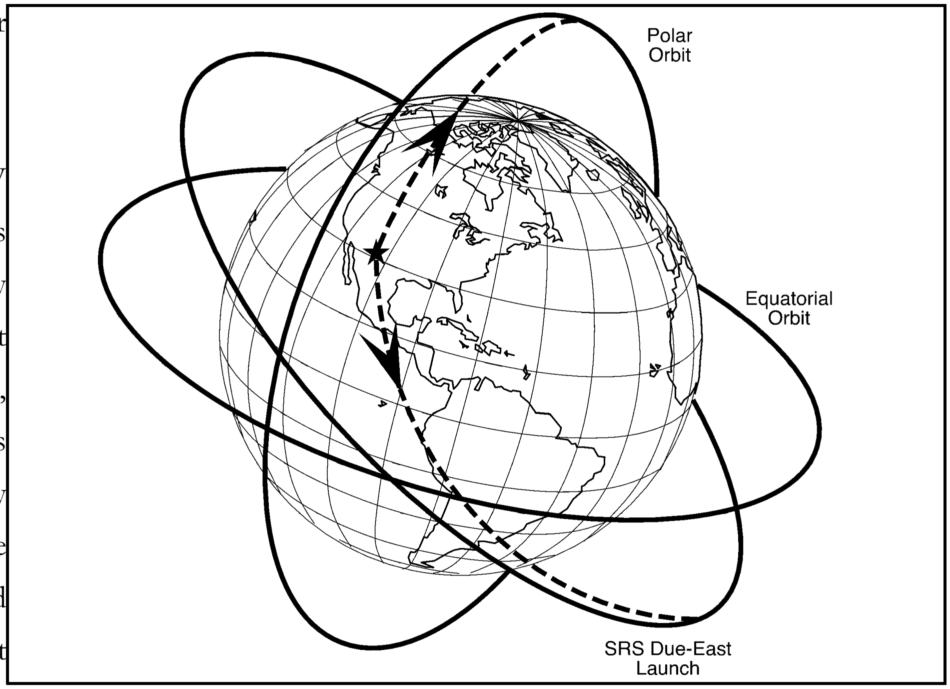

Figure 5. Some of the Possible Orbital Flight Paths from the SRS

Although the RLV launch profile is projected to be nearly vertical for the first portion of the flight, RLV launch operations would require a relatively large block of airspace that could be cleared easily of normal aircraft traffic to ensure flight safety. For inland locations, this type of airspace can be found in conjunction with military special-use reservations. Additionally, for the most common direction (easterly), the bulk of the airspace must be located east of the launch point. Consequently, the established restricted airspace controlled by WSMR provided the Grant I (NM 1995a) study team with an initial point of departure.

In summary, the State has proposed the SRS site because it is superior to the other candidate sites with respect to

- population density
- land use, ownership, and accessibility
- orbital insertion physics
- more convenient access to airspace
- lack of obvious environmental constraints

2.1.4 PROPOSED SRS LOCATION AND LAND AREA

The SRS is proposed to be located in south-central New Mexico in an area between Truth or Consequences and Las Cruces. This location is shown in Figure 6. The eastern SRS boundary would be contiguous with WSMR, and the western boundary would be approximately 16 miles east of Interstate 25 (I-25).

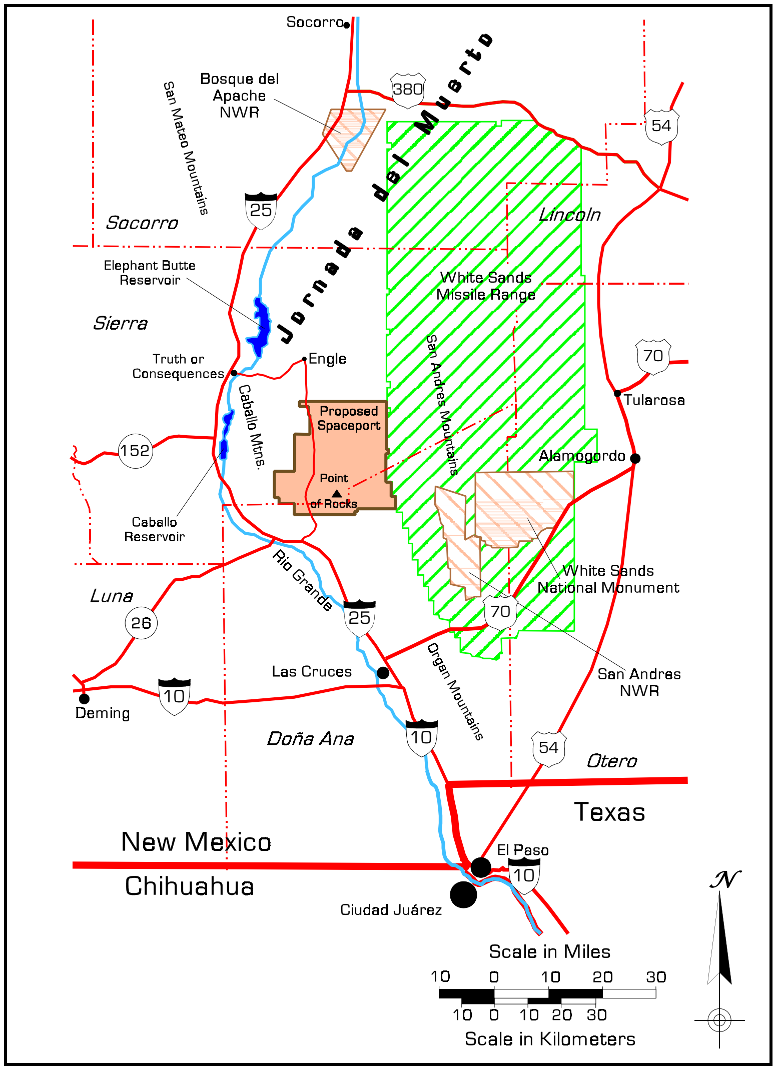

Figure 6. Project Location

The selected boundaries represented a projected area that could provide a satisfactory buffer for any viable operating site. Engineering and safety evaluations conducted subsequent to the NASA (NMSU 1995) and Grant I (NM 1995a) feasibility studies have indicated that the projected location evaluated during these studies would be a satisfactory location for the initial operating site. Potential sites S-1 through S-4 (Figure 4, page 31) fall within boundaries that were identified initially by the State of New Mexico (NM 1995a). Prior to issuance of the Notice of Intent, sites S-1 through S-4 were dropped from consideration as specific operating locations because they did not maximize use of state land and because of engineering and safety considerations. Subsection 2.2.3, beginning on page 81, discusses why these alternatives were eliminated from further detailed study in this EIS.

The proposed SRS facility would cover 247,398 acres, or approximately 387 square miles, that currently is under the following ownership:

- Federal public land 189,209 acres (76.5%)
- Private land 6,767 acres (2.7%)
- New Mexico State Trust Land 51,422 acres (20.8%)

The proposed site is situated primarily in Sierra County although some of the southern portion is located in Doña Ana County (Figure 6).

• Sierra County	184,500 acres	(74.6%)
• Doña Ana County	62,898 acres	(25.4%)

The proposed SRS site is situated between 32–33° North and 106–107° West at an average elevation of 4,500 feet. The land area available would allow space vehicles to ascend and return for landing within the proposed SRS boundaries.

2.1.5 SRS OPERATIONS

The SRS would be organized, operated, and managed in a manner similar to a commercial airport. It would be a publicly-owned enterprise incorporating private commercial activities and financial commitments. Also, as with an airport, public-use access would be controlled by a public entity (NMOSC), and private-use areas (vehicle assembly areas, launch/landing complex, landing areas, etc.) would be under the administrative control of individual SRS launch operators. Cryogenic fuel production, if implemented, would be a public enterprise with major investments by private-sector, space-related firms.

The spaceport management, organized as a commercial business, would be the host operator. Services, operations, and financial goals and objectives would be established, with policies and procedures installed to manage and maintain direction and growth as well as meeting launch operator support goals. Launch operators would be responsible to SRS for adhering to the SRS policies and procedures, all licensing requirements, and be responsible for the conduct of their personnel.

As an example, support organization services at airports typically are conducted by a variety of different methods. There are essentially two types of support supplied—control/safety and general services. Control/safety support would be provided by the SRS in one of two different manners. The SRS could enter into a contract with a security services provider or could rely on the local police and fire departments. General services would be provided in a similar manner. The launch operators would be required to adhere to security policies and procedures, as well as cooperate with security officials.

Various support services would be obtained from WSMR during the initial phase of SRS operations (Subsection 2.1.1.3, beginning on page 19). Other services would be obtained from WSMR on a continuing basis pursuant to a negotiated Memorandum of Agreement. This agreement would cover, but is not limited to, such items as the development of infrastructure in the Western WSMR Call-Up Area, integrated scheduling, integrated launch operations, mutually agreed upon flight safety criteria, and interchange of flight safety data.

2.1.5.1 RLV Flight Operations

The number of RLV orbital flights to be launched was estimated on the basis of the past and projected world-wide satellite launch rates. The world-wide orbital launch rate from 1957 to 1992, which was assumed to remain constant through 2010, was about 100 per year. From 1988 through 1992, there were 516 launches world-wide of which 104 (20%), or an average of 26 per year, were from the U.S. NM (1995b) projected a market for the RLV vehicle of 105 space missions from 2001 through 2006, 270 missions from 2007 through 2014, and 35 missions per year beginning in 2015. Some of the missions associated with SSTO orbital flights would include

- remote sensing (12 satellites per year by 2010)
- low-earth-orbit communications satellites (LEO Comsats) (5 to 25 per year by 2010)
- microgravity manufacturing (manufacturing in space without gravity) (6 to 14 flights per year)

2.1.5.2 Operations Air Space

The RLV concept emphasizes aircraft-like operability as one of the critical design features. This includes the capability to perform controlled launches and landings, as well as the ability to return to the same landing point even under emergency conditions (Subsection 2.1.1.1, beginning on page 15). RLVs may be designed for horizontal landing and such winged vehicles could use the proposed SRS airfield. Accordingly, the SRS Launch Site Operator License would establish operational boundaries and operational responsibilities that are similar to those of a commercial airport. A brief description of normal airport boundaries is provided in order to understand the commercial spaceport airspace concepts and boundaries examined in this document. This discussion is followed by a description of the operational and airspace boundaries applicable to the SRS. Because of the RLV's aircraft-like operability, the following subsections use a commercial airport and aircraft operations as a model to illustrate the operational concepts embodied in the proposed action.

Commercial Airport Boundaries

A typical large commercial airport has an operational control tower and approves instrument approaches to the airport. The tower has control over aircraft ground operations, approaches to, departures from, and aircraft flying within a 5-mile radius plus any extension required for instrument approaches. Airport control zones extend from the surface to 5,000 feet above ground level. En route instrument flight operations at cruise altitudes are monitored and controlled by regional FAA facilities linked to provide continuous transcontinental and international flight control. Aircraft performing instrument approaches to and departures from an airport are controlled by local control facilities while operating at intermediate altitudes.

In a typical flight scenario, the tower would provide instructions to aircraft taxiing for takeoff. The aircraft pilot-in-command would be responsible for complying with the tower's instructions and operating the aircraft safely on the ground. When the aircraft is ready for takeoff, the tower would coordinate with—and obtain approval from—departure control, then would give the aircraft clearance for takeoff. After takeoff and within the airport control zone, the tower and the pilot-in-command jointly would be responsible for safely establishing the aircraft on the approved flight path.

As soon as the aircraft is on the approved flight path, the tower would transfer responsibility to departure control. Departure control would be responsible for the aircraft until it reaches cruising altitude, or passes out of the local approach/departure control area, where responsibility would transfer to the regional control facility. The regional control would be responsible for the aircraft during the en route portions of the flight. At the destination, the reverse procedures would be employed through the approach control and destination tower. Although receiving instructions from various control agencies, the pilot-in-command would be responsible for safe operation and safe navigation of the aircraft.

Spaceport Boundaries

The proposed SRS procedures would establish a control zone around the launch and landing areas similar to a commercial airport control zone. The SRS would perform functions similar to the airport control tower and approach/departure control authority. Space vehicle operations on the ground and during the initial phases of flight would be coordinated and controlled within the control zone by NMOSC. The launch operator would have the same responsibilities as an aircraft operator or pilot-in-command with regard to vehicle operations and flight safety. As with the commercial airport analogy, flight operations outside the control zone (i.e., downrange) would be the responsibility of the appropriate control authority yet to be determined. It is unlikely that the SRS would be the downrange control authority.

It is anticipated that the SRS control zone would be a designated cylinder 10 miles in diameter around each launch/ landing site, with an upper limit of 60,000 feet above sea level as shown in Figure 7.

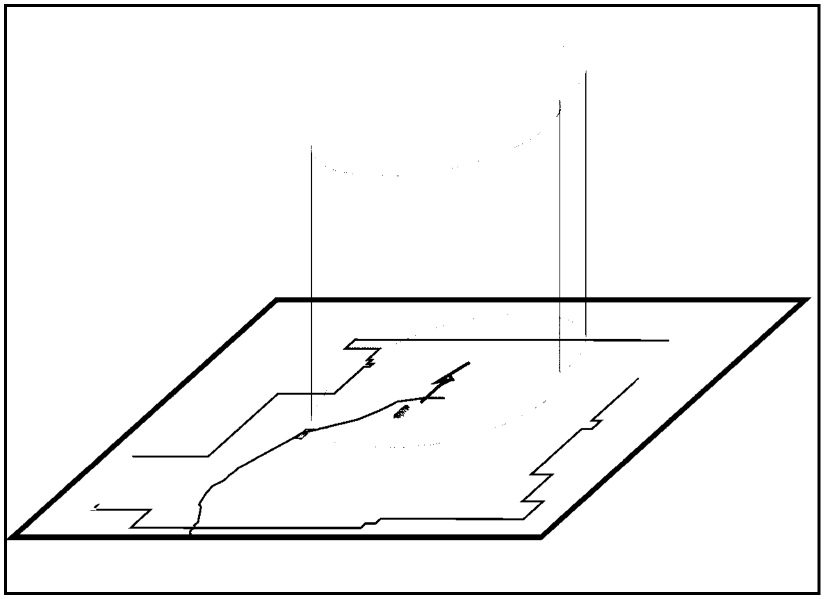

Figure 7. Airspace Boundaries

The surface area of the cylinder has been established through coordination with FAA/AST. It was based on analyses of projected operational characteristics of generic RLV designs available at the completion of scoping. The near-vertical launch and initial-climb profile of the generic RLV is shown in Figure 8. The greatest likelihood of failure of a launch vehicle typically is within the first 70,000 feet. Even if a failure were to occur within the airspace cylinder, the vehicle or its debris could land outside. Failures within this region

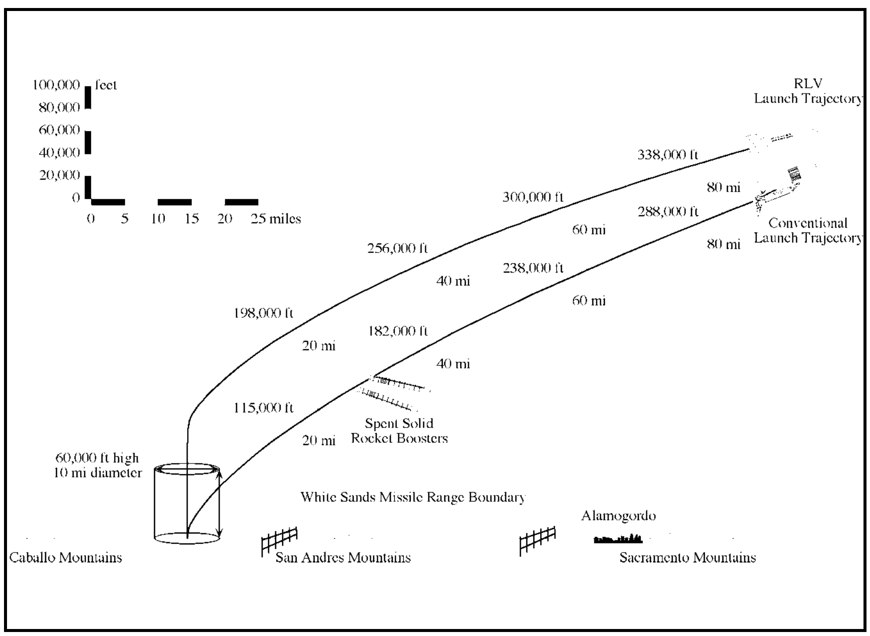

Figure 8. RLV and Space Shuttle Departure Paths
Data Source: Conventional profile (Holloway et al. 1975)

would be less likely to affect downrange safety than those from a conventional launch profile. For comparison, the launch profile of the Space Shuttle also is shown in Figure 8. The need for an over-water launch to satisfy downrange safety considerations for a conventional launch vehicle is apparent from this figure.

Current air-breathing, turbojet-powered, commercial aircraft do not operate above 60,000 feet, and few military aircraft operations exceed that altitude. NASA, military rockets, and missile-related space activities are the only uses of the airspace above 80,000 feet. Because the Launch Site Operator License would be issued by the FAA (Subsection 2.1.2.1, beginning on page 21), the vertical extent of the SRS control zone would be established at the limits of the airspace over which the FAA has control.

2.1.5.3 Operations Management

Management would establish policies to satisfy the FAA/AST guidance of August 1995, which specifies that SRS operations must be conducted safely to ensure the protection of the work force, the public, and the environment.

Operations management would have two goals. The first would be to create safe working conditions, safety for the public and visitors, and an unpolluted operating environment. The second would be to ensure that operations are conducted in compliance with Federal, State, and local regulations.

These goals would be accomplished by establishing specific operating policies, standards, and procedures for programs such as Environmental Safety & Health (ES&H) and for circumstances and operations such as

- Public affairs and visitor safety
- Cryogenic production
- Aircraft and airfield operations
- Spacecraft and launch/landing operations
- General industrial operations
- Site-wide environmental protection

These programs would address the day-to-day affairs of SRS operations in a manner that would satisfy the SRS license requirements, as well as regulatory agency requirements.

Operations Safety

Subsection 2.1.2, beginning on page 20, discusses FAA licenses and approvals required for the proposed SRS and private sector launch operators. The safety information required for license application is specified. This section addresses elements that would be required to demonstrate New Mexico's ability and its resource availability to operate the proposed SRS in a manner that would ensure public safety and safety to property, both within and outside of the SRS site. SRS operations would be conducted in an environmentally responsive and safe manner. The SRS would deal with potential safety concerns such as the storage and handling of propellants, fueling of launch vehicles and satellites, and other types of issues that would exist at an industrial facility designed to support a launch/landing complex. In order to meet environmental, safety, and health protection requirements, policies and standards would be established for operations, and instructions issued that would be tailored to SRS activities. These would be consolidated in the following documents and would be implemented by a trained and experienced staff. The purpose and content of these supporting documents is briefly discussed in the subsections that follow.

Launch Site Safety Operations Document

The Launch Site Safety Operations Document (LSSOD) governs how the facility would be operated to ensure public safety and safety of property according to the FAA requirements. The contents of the LSSOD are listed in Table 2.

Table 2. LSSOD Table of Contents

Section 1	Introduction and Purpose
Section 2	Safety Organization and Personnel Qualifications
Section 3	Safety Policies and Procedures
Section 4	Facility Layout
Section 5	Facilities and Equipment
Section 6	Facility Users
Section 7	Facility Access/Security
Section 8	Emergency Response Plan
Section 9	Accident Investigation Plan

Completion and approval of the LSSOD would be one of the first steps in the FAA licensing process. A license would not be issued unless the LSSOD adequately addressed each item in Table 2. With the issuance of the license, this information would become binding on the operations. SRS operations could not vary significantly without FAA concurrence. In fact, FAA inspectors would use the LSSOD during inspections to ensure that operations follow LSSOD criteria.

SRS Operations Environmental, Safety, and Health Manual

Whereas the LSSOD document is required for licensing, the worker safety requirements of the U.S. Department of Labor apply to licensed activities in accordance with the regulations for commercial space transportation licensing (DOT 1988). Worker safety regulations are issued by the Occupational Safety and Health Administration (OSHA) of the U.S. Department of Labor (29 CFR §1910). Regulations to protect the environment are issued by a number of agencies including the Environmental Protection Agency (EPA), the U.S. Fish and Wildlife Service (USFWS), and the National Park Service. In some cases, parallel or complimentary regulations have been adopted by the State of New Mexico and its various governmental departments. Section 6.0, beginning on page 315 contains a summary of Federal and State laws and regulations applicable to the proposed SRS.

The SRS Operations Environmental, Safety, and Health (ES&H) Manual is not required by any regulatory entity. However, this manual is proposed as a means to ensure that safety, health, and environmental regulations and standards are addressed. The purpose of the manual would be to provide written instructions and guidance for daily operations and activities of workers and private launch operators. In addition, the scope and completeness of the manual would provide guidance to comply with applicable Federal and State standards. Most private businesses and government facilities maintain similar manuals as an operational necessity to ensure environmental and safety compliance. Table 3 shows the table of contents for the proposed ES&H Manual.

Table 3. ES&H Manual Table of Contents

Section 1	SRS ES&H Policies
Section 2	Policies and Instructions for Supervisors
Section 3	Office Safety
Section 4	Industrial Safety
Section 5	Fire Protection and Emergency Services
Section 6	Industrial Hygiene
Section 7	Ionizing Radiation
Section 8	Explosives and Energetic Materials
Section 9	Environmental Protection
Section 10	Training
Section 11	Permits

Safety criteria established for the SRS also would be intended to protect the public. Once the SRS becomes operational, it is expected to attract visitors. It would be the intent of SRS to accommodate visitors by operating in a manner similar to a commercial airport. For example, portions of a commercial airport—such as the terminal building—are open to the public but access to fuel storage areas, aircraft hangars, runways, and maintenance areas is strictly controlled. Similarly, portions of the SRS—such as a visitor center proposed at the Spaceport Central Control Facility (SCCF) ("Spaceport Central Control Facility" beginning on page 58)—would be open to the public during periods when there are no launch or recovery operations. Other parts of the SRS would be restricted. Restricted areas would include fuel storage areas, the airfield and taxiways, launch/landing complex, maintenance areas, and areas where aerospace companies would handle RLVs and payloads for launch and recovery.

The ES&H manual also would address emergency planning and the coordination of plans with the State of New Mexico, Sierra, and Doña Ana counties emergency planning committees that were formed under the EPA's Emergency Planning and Community Right-To-Know-Act. A comprehensive emergency response plan for SRS would be prepared, and the inventory of chemicals whose quantities exceed the threshold planning quantities would be forwarded annually to the State of New Mexico and Sierra County. A comprehensive emergency response plan would include the following items:

- List of responsible personnel.
- the means by which emergencies would be reported and to whom the emergency would be reported.
- Identification of SRS locations and operations where chemicals are used and stored.
- Descriptions of the hazards of handling those chemicals.

- Descriptions of emergency equipment such as personal protective equipment, spill containment, and decontamination materials matched to the nature of the chemicals in use.
- Training programs and a schedule for exercises of the emergency plans.

SRS Launch Operator's Manual

The launch operator's manual is not an FAA requirement for licensing, but is included as part of the SRS proposal. The purpose of the manual would be to introduce prospective launch-site operators to the SRS. The manual would include information about the SRS, such as the restrictions and qualifications applicable for use of the SRS, and the launch and recovery services that would be available. This manual would define the safety interface procedures between the SRS and the operator. The manual also would define the types of flight safety data and safety preparations that would be acceptable to the SRS. An operator would be expected to demonstrate to SRS its ability to conduct operations within the limits of the SRS operating license before arrival at the site.

Prior to using the SRS, launch operators would be expected to have completed appropriate hazard analyses, safety reviews for the launch vehicle and payload, and to have obtained an FAA Launch License (Subsection 2.1.2.2, beginning on page 22). The SRS Safety Office and the Spaceport Operations Division would conduct a safety review to verify the operator’s data. A flight acceptance decision and mission review would be based on whether the vehicle and its payload could be flown safely. Similarly, an operator would be assured that appropriate safety reviews and risk assessments had been performed so their personnel and equipment would not be placed at risk while at the SRS. The SRS would assign a liaison engineer to aid in coordinating operator requirements with services available at the SRS. These engineers would be acquainted with SRS requirements and would aid in flight and recovery preparations.

Launch operators essentially would follow several phases of launch preparation—prelaunch processing, launch, recovery, and postlaunch processing. These preparations would be accomplished by the operator under rules and regulations issued by the SRS. It is the ultimate intention that mission planning would be controlled so that flight operations would be analogous to those of conventional aircraft (Subsection 2.1.5.2, beginning on page 37). All limitations established by the FAA/AST Operator's License for the SRS, including restrictions on flight paths, would be observed. Flight safety is discussed in Subsection 4.1.1.2, beginning on page 178.

Hazard Analyses

Under the FAA/AST Licensing Regulations, the ability to perform hazard analyses would be a requirement at SRS. Instructions and guidelines would be included in the ES&H Manual. For chemical hazards under normal operating conditions, or for foreseeable emergencies, this would be accomplished using chemical information and job hazard analysis/chemical hazard analysis techniques. These are narrowly defined techniques whereby potential hazards are identified by examining elements of individual work tasks. Typically, these methods are useful for protecting the work force and demonstrating compliance with OSHA safety and health standards. In addition, they reveal information about chemical wastes that would be subject to EPA waste disposal requirements and to the Emergency Planning and Community Right-to-Know Act (Section 6.0, beginning on page 315). Job hazard and hazardous chemical analyses would occur at the inception of SRS and would be continually applied as the facility matures.

OSHA's *Process Safety Management of Highly Hazardous Chemicals Standard* (OSHA 1992) requires a systematic examination of "critical processes" as a whole. A critical process is a term used by OSHA to define processes that use large amounts of chemicals or chemicals that are potentially dangerous. Process safety management is a proactive approach that targets processes and operations that would have the potential to cause a catastrophic incident. This standard would be implemented to prevent or mitigate chemical releases that could lead to a catastrophe in the workplace and possibly to the surrounding community. Possible examples at SRS where this standard would apply include

- aircraft refueling
- spacecraft fuel storage and refueling
- manufacturing of cryogenic liquid oxygen and hydrogen
- loading and unloading spacecraft
- handling flight hardware
- spacecraft launch and recovery operations

Another form of hazard analysis is system safety engineering. Generally, systems safety engineering would be applied to complex systems such as spacecraft design and procedural controls. The SRS would employ systems safety engineering techniques to design, equip, and operate the SRS facility. The systems safety concept is defined by Roland and Moriarty (1983) as

> . . . the application of special technical and managerial skills to the systematic, forward-looking identification and control of hazards throughout the life-cycle of a project, program, or activity. The concept calls for safety analyses and hazard control actions, beginning with the conceptual phase of a system and continuing through the design, production, testing, use, and disposal phases, until the activity is retired.

Possible examples at SRS where systems safety engineering would be applied include

- launch facility design and operations
- launch facility and space vehicle system interfaces
- routine and nonroutine launch procedures
- emergency preparedness planning
- range safety planning
- launch and recovery planning
- accident investigations

2.1.6 SRS Infrastructure Development

Development of the proposed SRS would consist of the following key elements, some of which are shown on the Project Overview Map in Figure 9:

- Land acquisition by the New Mexico State Land Office (NMSLO)
- Construction of access roads, vehicle ferry road, and parking areas
- Construction of the launch and landing facilities
- Construction of an airfield (landing strip) with a 12,000-foot runway
- Construction of a rail spur, rail terminus, and rail storage yard
- Construction of the Flight Operations Control Center (FOCC)
- Construction of the Spaceport Central Control Facility (SCCF)
- Construction of a Maintenance and Integration (M&I) facility
- Construction of a general maintenance building and machine shop
- Provision of utilities—electrical power, water supply for domestic use and the cryogenic fuel plant, propane or natural gas, solid waste disposal, sanitary waste disposal, and wastewater
- Construction of a cryogenic fuel production facility

Table 4 shows the estimated land disturbance for each SRS facility or service area proposed to be constructed.

Under Construction

Figure 9. Project Overview

Table 4. Amount of Disturbed Area for Each Building Site

Building & Pads	Footprint Area (sq. ft.)	Clear and Grade (acres)	Hauled Material[a] (cu. yds.)
Parking (all)	-b-	-b-	14,700
Launch/landing pad 1	90,000	8.3	8,500
Launch/landing pad 2	90,000	8.3	8,500
Launch/landing pad 3	90,000	8.3	8,500
Railroad spur	500,940	11.5	6,562
Loading dock & storage yard	52,500	1.2	1,458
FOCC	4,000	1.7	250
SCCF	10,000	5.2	600
M&I facility	18,000	2.6	100
Warehouse	8,400	2.1	550
Communication & power	1,250	0.3	80
Cryogenic fuel plant	80,000	24.8	1,600
Fire and security	2,400	2.7	150
Helicopter landing area	3,600	1.2	150
Solid waste storage	9,600	0.5	600
Pyrotechnics storage	1,600	0.4	90
Airfield	21,600,000	362.6	2,400,000[c]
Power line[d]	431,300	23.8	0
Natural gas line[d]	431,300	23.8	4,790
Water line[d]	558,300	61.5	6,200
Proposed roads (24' wide)	5,778,432	285.0	240,907
Proposed roads (100' wide)	1,953,600	56.0	61,250
Total	31,715,222	891.8	2,765,537

a Hauled Materials are those transported to the construction site from borrow pits, those transported from the construction site to disposal areas, and those (cut and fill) transported from one area to another within the construction site.
b Parking lot figures are included in the footprint for facility with which they are associated.
c This figure would include 600,000 cubic yards of caliche transported from borrow pits within the SRS boundaries. The remainder of the quantity would be on-site cut and fill materials.
d External routing from point of supply to SRS internal terminus. Existing road rights-of-way are used or rights-of-way are shared for internal routing.

2.1.6.1 Land Acquisition

This section describes the procedures to be followed in acquiring BLM and private land for development and operation of the SRS. The purpose of the land acquisition would be to consolidate what are now State Trust, BLM, and private land under State management through outright purchase of needed private land and exchanges of Federal BLM land for New Mexico State Trust Land.

The proposed SRS boundaries are displayed in Figure 9. The area is described in Subsection 2.1.4, beginning on page 35. These boundaries have been used to determine the limits for the analyses of impacts discussed in this EIS, and for land-acquisition, initial-planning parameters.

During the RLV development program, technological and engineering advancements in the actual commercial RLV design not considered in the current conceptual design could allow a change in the proposed SRS boundaries. Under those conditions, the data used in the following discussions would change in terms of the numbers of acres involved in supporting various SRS configurations. Nominally, the numbers of acres involved would decrease.

Under the anticipated land-acquisition transactions required for the proposed SRS configuration, up to 6,767 acres of private land in Sierra and Doña Ana counties would be purchased and up to 189,209 acres of BLM land would be exchanged for State Trust Land located elsewhere in New Mexico. Except for certain safety requirements to be imposed during launches of space vehicles, existing land uses at the proposed SRS facility such as agriculture, mining, and recreation would continue with only minor interruptions. The existing relationship between WSMR and the NMSLO regarding the Western WSMR Call-Up Area would not be affected.

Exchanges of BLM Land for State Trust Land

Before a land exchange between BLM and NMSLO may occur, BLM must amend its Resource Management Plan (RMP) to make the Federal lands at issue available to be exchanged. The Secretary of the Interior must conduct the RMP amendment process in accordance with criteria for developing or revising land use plans as set forth in applicable statutes and BLM regulations (43 U.S.C. § 1712 [1995]; 43 CFR Part 1600 [1996]). Guidance in the RMP amendment process may come from BLM officials, national level policy established through legislation, regulations, and executive orders, or other specified sources. Amendment of the RMP is a proposed Federal action requiring compliance with the National Environmental Policy Act of 1969. BLM regulations require that the public shall be provided with opportunities to meaningfully participate in and comment on proposed amendments to RMPs. At the initiation of the RMP amendment process, BLM must publish a notice in the *Federal Register* and in other media within the state of the proposed land exchange. BLM also is required to contact individuals and groups who are known to be interested in the proposed land exchange. In addition, BLM must provide opportunities for public participation at several designated stages during the RMP amendment process.

During the RMP amendment process, BLM must coordinate with other Federal agencies, state and local governments, and Native American tribes. RMP amendments must be consistent with resource-related plans of these other entities, so long as their plans do not conflict with applicable Federal laws. If there are any known inconsistencies, BLM must notify the State governor and then follow designated procedures before approving an amendment to an RMP.

The RMP amendment process has several stages. First, BLM regulations require that BLM seek public input to identify issues. Next, BLM must develop panning criteria, inventory data, and collect information. BLM officials must then analyze the circumstances to determine whether the lands or resources in question will resolve the issues or take advantage of the opportunities presented by the proposed RMP amendment. Finally, BLM officials must consider all reasonable resource management alternatives, including no action, estimate the effects of these alternatives, and then select the preferred course of action.

Under Section 206 of the Federal Land Policy and Management Act of 1976, the Secretary of the Interior may exchange BLM land desired for the proposed SRS for State of New Mexico Trust Land located elsewhere, if the Secretary of the Interior determines that "the public interest will be well served by making the exchange" (43 U.S.C. § 1716(a) [1995]). In making such a determination, the Secretary must give full consideration to improving Federal land management and the needs of state and local residents, including land needed for economic development and community expansion, along with several other specified objectives such as recreation areas, food, fiber, minerals, fish and wildlife. WSMR requirements would be considered in the acquisition process. The Secretary also must find that the value of the BLM land, if retained in Federal ownership, would not exceed the value of the public objectives that would be served by proceeding with the proposed land exchange. The NMSLO would be the State transfer agency.

The value of the State Trust Land exchanged for BLM land must be equal to the value of the BLM land (43 U.S.C. § 1716 (b) [1995]). If the State Trust Land were to be appraised at a lesser value than the BLM land, the value could be "equalized" by the State paying an amount that would not exceed 25% of the value of the BLM land. The parties may mutually agree to waive these equalization payments, but the waiver would be limited to 3% of the value of the BLM land or $15,000, whichever is less. Generally, the parties to a land exchange will each bear their own costs; however, in certain circumstances, the parties may agree otherwise.

General procedures and specific requirements governing exchanges of BLM land are contained in 43 CFR Part 2200 (58 *FR* 60918, November 18, 1993). The regulations expand on the criteria for determining the types of exchanges that are in the "public interest" by including among the objectives to be attained "consolidation of lands and/or interests in lands . . . for more logical and efficient management and development" and "fulfillment of public needs" [43 CFR §2200.0-6(b)]. These are among the objectives that would be attained by development and operation of the SRS.

In accordance with Federal Land Policy Management Act (1976), a number of specific requirements would apply to a proposal to exchange BLM land for State Trust Land in order to consolidate NMSLO control of the SRS. Among these are

- Preparation of an environmental analysis by the BLM to comply with NEPA.
- Performance of minerals survey and draft minerals report.
- Provision of notice by both parties of any known hazardous substances on the lands to be exchanged.
- Appraisal of both the BLM and the State Trust Land to be exchanged. The appraiser must have the required qualifications and must follow specific guidelines in estimating market value and reporting appraisal result. Appraisal reports must then be reviewed by a qualified review appraiser.
- Participation in a bargaining process or arbitration if the parties wish to proceed after receiving the appraisals.

- Publication of a public notice of the proposed exchange in the counties in which the BLM and State Trust Land are located.
- Provision of notice to BLM and State Trust Land users (including holders of grazing leases and mineral interests), State and local governmental agencies, and the New Mexico Congressional delegation.
- Invitation to the public to submit written comments or concerns pertaining to the proposed exchange.
- Decision by an authorized BLM official to approve or disapprove the proposed land exchange.
- Publication of the exchange decision (approval or disapproval) in newspapers of general circulation and the *Federal Register* as well as provision of additional notices to public land users, State and local government agencies, and the Congressional delegation.
- Allowance of a period of 45 days following the exchange decision for initiation of protests, followed by an opportunity to make an administrative appeal.
- Provision of required evidence of title to BLM, and simultaneous exchange of the BLM and State Trust Land.

Depending upon the type of disposal proposed, the minerals report may be required to assess the mineral potential or character of the involved land or determine if disposal of the surface would interfere with the development of the mineral estate. Recommendations would be made concerning the suitability of the parcel for disposal based upon the findings of the report. In this way, impacts to mineral exploration and development resulting from land disposal would be minimized.

Early in the land exchange process, BLM and NMSLO may choose to enter a nonbinding agreement to initiate an exchange and also may seek preliminary estimates of the value of the lands to be exchanged. If BLM ultimately approves the proposed land exchange, the parties may enter into a land exchange agreement. If the parties choose to execute such an agreement, then BLM regulations require that it must contain certain specified elements.

The State of New Mexico Trust Land that would be exchanged for the Federal land managed by the BLM is managed by the New Mexico Commissioner of Public Lands (Land Commissioner). The Land Commissioner is the elected official responsible for managing State Trust Land pursuant to the State's Enabling Act and statutes affecting State Trust Land, 19-1-1 *et seq.*, NMSA. The Land Commissioner exercises his authority through the New Mexico State Land Office (NMSLO).

The State statutes regarding State Trust Lands anticipate and include approved provisions for exchange of State Trust Land for Federal land. To provide procedures for facilitating the appraisal and exchange process, NMSLO and BLM have in place a negotiated Memorandum of Understanding that allows for exchanges to take place on a "running account" basis. Correspondence from the New Mexico State Office of the BLM indicates that the projected land exchange would be possible under this Memorandum provided stipulations of the Federal Land Policy and Management Act and supporting regulations are met (BLM 1997a, 1997b; Appendix B). Approximately 100,000 acres of land were exchanged under this Memorandum in 1995–1996.

Acquisition of Private Land

The proposed SRS area contains 6,767 acres of private land held by 13 individuals or corporate entities. In addition, the Atchison, Topeka, and Santa Fe Railway (AT&SF) owns the right-of-way consisting of a strip of land 100 feet on either side of the tracks. The distribution of Federal, State, and private holdings is discussed in Subsection 3.8.1, beginning on page 140. The Federal and State grazing allotments covering the SRS area are distinct from private land ownership. These grazing allotments are held by eight ranching operations. However, two ranch operations own 1,501 acres of land in the immediate vicinity of the SRS and control the grazing allotments in the primary area of initial SRS development. Five currently-occupied private residences are located on these two ranches. These holdings would constitute the initial State acquisition of private land.

The current New Mexico position is that private land required for SRS development would be acquired by direct purchase or other transfer mechanism. It is anticipated that the NMSLO would be the landowner and would lease the necessary land to the appropriate State agency. Acquisition of the private holdings in the proposed SRS area would be initiated by the State Legislature, authorizing the applicable State agency to entertain exchange proposals from the private land owners pursuant to New Mexico statutes and regulations. The present land owners would receive adequate, negotiated compensation. The range of potential negotiated settlements include direct purchase, "life estate" occupancy agreements, leaseback agreements, relocation exchanges and/or transfers, or variable combinations of any of these possibilities. The final form of the transfer agreements would be negotiated by individual landowners and the State of New Mexico.

As there are existing agricultural (grazing) lessees/permitees of the subject properties, it would be the responsibility of the leasing State agency to gain relinquishments of the leases or permits, and to compensate the existing lease or permit holders for their improvements to the land according to State rules and regulations. A primary land-acquisition objective would be for the New Mexico to be owner of the land within the SRS boundary.

When design, testing, and FAA airworthiness licensing phases for the commercial RLV have been completed, and commercial space launch and recovery operations have been proven technically feasible, acquisition of the remaining private land within the SRS boundaries would be required to complete the SRS development. This land would be acquired in the manner discussed above. For the purposes of analyzing environmental impacts for this document, it was assumed that the land encompassed by the proposed boundaries would be acquired. There are no plans to acquire land currently owned by the AT&SF.

2.1.6.2 Standard Construction Practices

Construction of proposed SRS facilities would be the responsibility of the applicable agency of the State of New Mexico. Standard State of New Mexico design, contracting, construction, administration, and monitoring procedures would be used. During construction, routine construction safeguards and Best Management Practices would be employed to avoid or minimize potential environmental impacts. These practices include, but are not limited to

- Fugitive dust generated by road, pipeline, and airfield construction would be controlled by using water sprays and fogs from water trucks. Chemical dust retardants would be used where appropriate.
- Cultural resource and sensitive species surveys would be completed prior to construction of roads, pipelines, transmission lines, and other land-disturbing activities.
- Cultural resource (historic or prehistoric) sites eligible for nomination to the National Register of Historic Places would be avoided as much as possible. Where these sites could not be avoided, further testing, evaluation, and data recovery would be undertaken. If archaeological or historic resources were discovered during excavation or soil removal activities, work would be halted and a qualified archaeologist would be asked to make an assessment. The appropriate land-management agency, (i.e., BLM or NMSLO) and the State Historic Preservation Officer also would be contacted.
- Federal or State sensitive species, and associated designated habitat, would be avoided where possible. If isolated sensitive plants were found in areas to be disturbed, individual plants would be transplanted to suitable habitat outside the area of disturbance. All above-ground electrical power lines would be constructed or modified using BLM or Raptor Research Foundation guidelines to prevent electrocution of raptors (RRF 1981). As requested, all wolves and Northern Aplomado Falcons observed in the area during construction would be reported to USFWS and New Mexico Department of Game and Fish (NMDGF).
- Disturbed areas would be recontoured and revegetated as soon as possible, either during or immediately following construction. Only indigenous species that would not require irrigation would be used.

- Outdoor lighting would be shaded or otherwise designed to maintain a dark sky environment for local astronomical observations and minimize lighting annoyances.
- OSHA regulations in 29 CFR Part 1826 would be strictly applied to protect construction workers.
- Construction-related borrow pits would be located in compliance with historic preservation and wildlife protection laws and would be closed, recontoured, and revegetated when no longer needed.
- Surface water runoff from precipitation events would be controlled according to EPA storm-water discharge requirements (Section 6.0, beginning on page 315). Runoff from construction activities, industrial-type facilities, and the airfield would not be allowed to accumulate in ponds, ditches, and other construction-related, low-lying areas—in part to prevent creating a wildlife hazard.
- Parking lots would be constructed to allow proper drainage and to minimize fugitive dust.
- The SCCF and other buildings in the core area would be designed to conform to an historical New Mexico architectural style. Colors and materials would be used on all structures to blend with the surrounding landscape as much as possible.

2.1.6.3 Transportation, Access Roads, and Parking

Air, roads, and rail are the methods used to transport personnel, material, and fuel to a landlocked spaceport such as the proposed SRS. The SRS would be made accessible from I-25 by a heavy-duty, two-lane road. This road would be used for transporting personnel, construction materials, launch vehicles, payloads, and propellants. Additional paved on-site roads would provide connections between the SCCF, the airfield, the FOCC, the cryogenic fuel plant, the M&I facility, and the launch/landing complex (Figure 9, page 48). Some roads would be unpaved, maintained roads and would be adequate for minimal traffic (e.g., security patrol.)

All roads serving the SRS would be aligned and constructed to standard practices so that grades would not be too steep for heavy vehicles to operate safely. Adequate storm-water drainage would be provided. Paved roads would be no less than 24 feet wide with at least one lane in each direction. Design parameters would consider the size of vehicles, speed, and traffic volume. The roads that would be constructed or upgraded are (Figure 10)

- Paved two-lane primary access road from near Rincon to Upham. This road would be the primary link between the SRS and I-25. It would provide the principal access to the proposed SCCF, the "core area," and the railroad terminus. The existing gravel road along the AT&SF tracks would provide the basic alignment and would be upgraded and paved to accommodate large trucks with heavy loads. This road eventually may be extended to connect with State Highway 51 at Engle, 16 miles east of Truth or Consequences.
- Paved roads would connect the SCCF and railroad terminus at Upham with the proposed airfield, the FOCC, the cryogenic fuel plant, and the launch/landing complex.
- Other minor roads, mostly unpaved gravel, would serve utility corridors or be used for maintenance and security.

It is estimated that 45.6 miles of road with 24-foot-wide pavement and 3.7 miles of road 100 feet in width (the "ferry road" from the airfield to the launch/landing complex and M&I facility) would be required for the SRS. Both paved and unpaved parking lots encompassing approximately 99 acres would be constructed at the SCCF, the airfield, the FOCC, the cryogenic fuel plant, the M&I facility, and the launch/landing complex.

Roads within the site used to connect activities would be paved. Construction design would be dictated by usage requirements. Borrow ditches 12 feet beyond each shoulder would be the limit of construction. The roadway would be elevated above existing ground level by base

Figure 10. Project Facilities

course material and pavement. In low-lying areas, sub-base material—needed to raise the base course above any locally occurring surface water—would be hauled from the nearest on-site borrow source. Selected and processed material for the base course would be hauled from an on-site processing plant. Surface or paving course material would be hauled from a plant located near the intersection of the SRS access road and I-25. A summary of a road lengths, widths, and activities associated with their construction is presented in Table 5.

Table 5. Road Summary

	Miles	
Road	24-ft width	100-ft width
I-25 to SCCF	18.5	
SCCF to NM 51	20.5	
SCCF to FOCC	5.4	
FOCC to M&I	1.0	
Spur to cryogenic	0.2	
M&I to launch/landing pad 1		0.5
M&I to launch/landing pad 2		0.5
M&I to launch/landing pad 3		1.0
Launch pad 2 to airfield		1.7
Total	45.6	3.7
Clear & Grade	285 Acres	56 Acres
Compacted Sub Base	658,000 sq. yd.	230,000 sq. yd.
Compacted Base Course	147,000 cu. yd.	52,000 cu. yd.
Paving	650,000 sq. yd.	217,000 sq. yd

Spaceport Central Control Facility

The SCCF, proposed to be located at Upham, would serve as the "front gate" and the central "hub" for most SRS activities. It would be composed of seven elements including administration, maintenance support, logistics support, mission planning, flight operations, ground operations, and vehicle/payload operations. The SCCF would house an integrated ground- and flight-management control unit for all space vehicles using the SRS. All ground- and flight-control activities would be coordinated and managed from the SCCF or the FOCC.

This integrated ground- and flight-management unit would be equipped with state-of-the-art computers, software, control consoles, communications, and data acquisition equipment necessary for support of preflight, in-flight, and postflight operations. Multiple missions could be managed simultaneously by this facility.

The SCCF would be a two-story building, approximately 50 × 200 feet, containing approximately 20,000 square feet. Its construction would conform with all building, electrical, plumbing, fire protection, and other codes. In addition to offices and launch control/support areas supporting approximately 100 people, the SCCF would have an auditorium capable of handling up to 250 people and a small visitor center. A discussion of tourism is included in Subsection 4.10.1.1 beginning on page 277. The building would be constructed as a pre-engineered steel structure with a pitched metal roof and architectural stucco panel consistent with historical New Mexico style architecture. The design would minimize any visual intrusion experienced by visitors to the historic El Camino Real (Subsection 3.6.6, beginning on page 134). A helipad providing alternate transportation for distinguished visitors and emergency evacuation capabilities would be constructed adjacent to the SCCF. It is anticipated that the facility would be used fewer than five times a month during full operation. Therefore, use of the helipad would not result in significant cumulative environmental degradation from noise, dust, or engine emissions.

Warehouse/Shop/Equipment Facility

This building would serve as the hub of support activity for the SRS. Three activities would be housed in this building in order to provide economies in construction.

- *Warehouse*. The warehouse would serve the storage needs of the SRS as well as the needs of operators conducting business at the spaceport. As an example, if a vehicle operator were to have equipment or supplies shipped to the site, the warehouse would provide receiving and storage service. Site operations and maintenance supplies also would be stored and distributed from this facility. This building would be a pre-engineered structure with a pitched metal roof and prefabricated stucco panels. The warehouse portion of the building would be 60 × 60 feet, or 3,600 square feet.
- *Machine Shop*. This would be a basic machine shop providing support for space vehicle operators and spaceport general functions. The shop would provide equipment such as mills, lathes, drill

presses, metal forming equipment, and welding equipment. This portion would be approximately 20 × 50 feet, or 1,000 square feet.

- *Equipment Facility*. This portion of the building would serve as a garage and minor repair facility for rolling vehicles and equipment. Cars and pickup trucks used in the daily operation of the SRS would be serviced and stored at the equipment facility. This portion of the building would be approximately 60 × 60 feet, or 3,600 square feet, and would contain service bays with drive-through capabilities.

The three activities in this building would require

- shop gases, including compressed air
- a 15-ton bridge crane in the shop
- small office space
- overhead coiling doors
- oil storage
- secure storage areas

Fire Station and Site Security Office

Regardless of who provides the services, on-site fire protection facilities and equipment would be required. A two-bay fire station collocated with a site security office would be required. The fire station would contain space for three pieces of fire-fighting equipment—two trucks and a rescue vehicle. This service would provide emergency assistance to SRS operations including launch, landing, and airstrip activities. It is anticipated that fire and rescue equipment would be stationed at launch and landing sites as schedules require. The facility would be a pre-engineered structure with pitched roof to match the other SCCF-area structures. The building would provide support services for the equipment and the capability to house personnel on a 24-hour schedule. The site security would be a 24-hour operation providing both physical and electronic surveillance. The structure would be approximately 40 × 60 feet, or 2,400 square feet.

Railroad Spur, Terminus, and Storage Yards

Railroad access would be critical because of the remoteness of the SRS site and the need to transport large quantities of material and heavy or large-size equipment. The AT&SF currently operates in a north-south direction through the western portion of the SRS site. A railroad spur, approximately 5,000 feet in length, and terminus would be constructed at Upham. The terminus would be used to unload, store, and distribute launch vehicle components, payloads, and other support equipment and materials arriving by rail. For example, in order to construct various SRS facilities, large quantities of bulk cement might be transported by rail to Upham then trucked to an on-site concrete plant. Storage yards covering approximately 52,500 square feet would be required in the immediate vicinity of the rail spur.

Fuel components would not be shipped to the SRS by rail because cryogenic tank cars are not available for private commercial use. However, cryogenic storage tanks, or other equipment that is too large for shipment by truck, would be shipped by rail. Subsection 2.1.6.8, beginning on page 74, is a discussion of the proposed cryogenic fuel plant for the production of liquid oxygen and liquid hydrogen.

Pyrotechnics Storage Facility

The pyrotechnics storage facility would be an earth-bermed structure used only for storage of limited quantities of small explosive devices used by space vehicle operators for launch vehicle hold-down, payload separation, and other purposes. Rocket motors used to boost payloads from parking orbit to final orbit also would be stored here. An example would be the Inertial Upper Stage, which does not reenter the atmosphere. Although this rocket motor contains 27,400 pounds of solid propellant, it poses relatively little hazard because solid rocket propellant tends to burn rather than explode. Adequate safe handling techniques have been developed for these devices. The facility would provide a safe, secure storage location. The structure would be approximately 40 × 40 feet, or 1,600 square feet, and would incorporate standard industry explosion-proof construction. It would be located and constructed in conformity with all applicable regulations.

Waste Loading Facility

This facility would consolidate hazardous and nonhazardous waste for transport to approved off-site facilities for disposal, treatment, or recycling. Prepackaging of waste would take place at this facility.

2.1.6.4 Airfield and Helicopter Landing Areas

An inland spaceport like the proposed SRS lacks the capability to receive large space vehicles or payloads by ship or barge. For this reason, it must be capable of accommodating air transport in addition to ground transport vehicles. Some space vehicle payloads (e.g., life science and biological experiments) would require rapid transport to distant laboratory locations. Emergency response teams and fire-fighting teams may require air transport from outside locations.

The airfield proposed for the SRS would fulfill these needs and provide additional logistical support for commercial space program operations. It would have the capability to land large cargo aircraft, payload recovery aircraft, commercial aircraft, RLVs that land horizontally, winged reentry vehicles, and helicopters. Further, RLVs that normally land vertically could use the airfield landing strip if unable to land at their normal landing pad. In addition, several helipads would be provided at strategic locations.

The proposed airfield would have a 12,000- × 300-foot runway to serve large transport planes. The runway would be aligned in a north-northeast/south-southwest direction (Figure 11). At each end of the runway there would be a 3,000- × 3,000-foot clear area, a 5,000- × 3,000-foot Accident Potential Zone (APZ) I, and a 7,000- × 3,000-foot APZ II. Aprons and taxiways also would be required. A cargo-handling area would be provided to unload vehicles and components that arrive at the SRS on large cargo aircraft. Vehicles and components may be flown in the cargo hold of the aircraft or "piggy-back" in the manner in which Space Shuttles are transported. All analyses use a Boeing 747 as the proxy aircraft.

Figure 11. Airfield Ground Surface Clearance and Compatible Use Zones

Sophisticated landing and takeoff control systems and navigation aids would be provided, although a control tower is not presently contemplated. Fire-fighting and other emergency response facilities and equipment also are proposed. It is expected that the airfield would be used infrequently (two or three times a week) by cargo, corporate, or government aircraft. The airfield would conform to all FAA requirements (Subsection 2.1.2.4, beginning on page 25).

A cargo-handling hangar located at the airfield would provide shelter and mechanical capabilities to load or unload the Boeing 747 and RLV vehicles or component parts. The facility would consist of a 200- × 120-foot building (24,000 square feet) 120 feet high. A two-hook, 50-ton-capacity, overhead crane would handle the spacecraft and lower it onto the vehicle ferry for transport to the launch area. The building would have rolling hangar doors, parts storage, a small office, and a restroom. The design and color of the building would be selected to minimize visual impacts.

The total area of land disturbance required for the proposed airfield would be approximately 360 acres. However, the total area of restricted land use associated with the airfield, including clear areas and APZs, would be approximately 2,150 acres.

2.1.6.5 Maintenance and Integration Facility

The maintenance and integration (M&I) facility has two functional areas, the vehicle area and the payload-processing area. Vehicles or vehicle parts arriving at the airfield would be transported to the M&I facility. The M&I building would be used for space vehicle repair and maintenance, assembly, ground testing, and some parts manufacturing. The vehicle area would have a high bay with a clear height to the overhead crane hook of 120 feet. The adjoining portion of the building would be the payload processing area. This space would be two-story open bay area with a clean room. In this area, customers would prepare payloads for loading into the space vehicle. This would be a restricted area for safety and security purposes. The payload propellant building would be adjacent to the M&I facility. Compressed gases used by payload operators, and rocket motors used to boost payloads from parking orbit to final orbit would be stored in this building during final vehicle assembly. The M&I building would be 120 × 100 feet, or 12,000 square feet, 160 feet high, with the payload processing area being 60 × 80 feet. The propellant building would be approximately 45 × 30 feet, or 1,350 square feet.

The M&I facility would be located a safe distance from all SRS launch and landing areas. A “ferry road” would be used to transport cargo arriving at the airfield to the M&I facility. The design and color of the building would be selected to minimize visual impacts.

2.1.6.6 RLV Operations Area

The current design includes three pads in the RLV Operations Area to be used primarily for vertical launch and landing operations. Horizontal operations would be conducted in the airfield area (Subsection 2.1.6.4, beginning on page 62). Operations at any of the pad areas would be controlled through the FOCC.

Launch/Landing Complex

The three proposed launch/landing pads would consist of extensive facilities with program flexibility built in. The concrete base structure would be 300 × 300 feet sitting over a 40- × 60-foot blast trench that would safely divert the rocket engine exhaust blast. The launch/landing pad would include a track-mounted, rolling shelter capable of supporting a proposed 50-ton crane with a 120-foot hook height. The rolling shelter would be a lightweight shell, the color of which would be selected to minimize visual impacts. The upper portion of the shelter would contain a clean-room environmental enclosure. This environmentally conditioned space would provide protected access to the payload bay of the spacecraft and would be accessible by way of an elevator. The launch/landing complex would include recessed utility trenches, retractable lightning protection, and area lighting.

Subsection 2.1.6.8, beginning on page 74, describes the liquified gas requirements at the launch sites. Liquid oxygen, liquid hydrogen, as well as gaseous helium, nitrogen, oxygen, and hydrogen would be stored near the launch site. These tank units would be above ground and would be protected by earth berms. The delivery system would be above ground pipe supported on pipe racks.

Each launch/landing pad would be provided with a water deluge system capable of delivering up to 30,000 gallons of water during a lift-off burn. The water would cool and protect the launch platform and provide noise and vibration dampening during lift off.

The proposed SRS site would be served by a 100-foot-wide vehicle ferry road running between the airstrip, the M&I facility, and the launch/landing complex (Figure 10, page 57). Underground power and communication lines would serve the area.

Flight Operations Control Center

The FOCC (Figure 10, page 57) would serve as the program control center. This structure would be dedicated to the flight operations of a particular spacecraft, as compared with the SCCF that would provide control and administration for the SRS facilities.

The FOCC would be 100 × 40 feet, or 4,000 square feet, and would house control consoles, computer data handling, and storage. The building would contain a room protected from radio-frequencies and a room for secure operations. The structure would be constructed of pre-engineered components with a pitched metal roof and prefabricated architectural panels simulating stucco. As with the SCCF and other structures, the FOCC would be designed to minimize visual effects. Telecommunication dishes and radio antennae near the building would be visible. There also would be a separate small concrete structure (1,250 square feet) to house communications, power, and a restroom.

2.1.6.7 Utilities

Electrical power, water, propane or natural gas, waste disposal, sanitary sewers, and wastewater treatment would be provided to service the SRS. This section discusses each of these utility needs. Outside the proposed SRS boundaries, minor variation to routing of the water and gas pipelines and electrical transmission line are possible. It is assumed that the approximately 18.5-mile 40-kV overhead transmission line from Rincon to SCCF, the approximately 20-mile natural gas pipeline from Rincon to SRS facilities, and water pipelines from local water wells and Elephant Butte Reservoir to a water treatment plant near the FOCC generally would follow existing and proposed rights-of-way, minimizing areas of disturbance. Final routings cannot be determined until detailed engineering designs and negotiations with potential suppliers have been completed. Installation through an undisturbed area would require a corridor up to 24 feet wide for one or more lines. Installation along an existing road would require a 12-foot wide corridor for one or more lines. Because all areas to be crossed are topographically and ecologically similar, the expected magnitude of the environmental effects would not be substantially different for any configuration.

The State of New Mexico is in the process of developing detailed engineering designs and negotiating with potential suppliers to develop final designs and routings. To the maximum extent practicable, detailed surveys to meet all requirements, such as any biological assessment under the Endangered Species Act or cultural resources surveys under the *National Historic Preservation Act, Archaeological and Historic Preservation Act,* and New Mexico statutes, will be completed and the information disclosed in this EIS. Construction will not commence until appropriate environmental review has been completed and necessary permits have been obtained.

Electrical Power

It is estimated that SRS development would require peak electrical power of 40 megawatts (MW). Electrical power would be required for heating and air conditioning of buildings, payload processing, launch areas, radar, telemetry, airfield operation, and operation of the cryogenic fuel plant. Although a 345-kilovolt (kV) transmission line belonging to El Paso Electric Company runs north-south through the SRS site (Figure 9, page 48), this line is for long-distance transmission only and cannot be tapped to meet SRS needs. For this reason, a new 40-kV overhead transmission line would be constructed from a substation at Rincon to a substation near the SCCF, a distance of approximately 18.5 miles. Another 5.7 miles of overhead transmission line would be required to serve the M&I and the FOCC. Underground distribution lines would serve the cryogenic fuel plant, the airfield, and the launch/landing complex. Overhead sections require poles at approximately 300-foot intervals, and placement of each pole typically affects a 5-foot diameter area. Underground sections typically affect a 5-foot-wide strip of land with minor disturbance in a 12-foot wide corridor.

Complete information concerning the design and routing of the proposed transmission line currently is not available. Detailed design information would be developed by the electric utility following a decision to proceed with the SRS. However, for purposes of the analyses of cumulative environmental impacts in Subsection 4.12, beginning on page 293, conservative assumptions have been made with regard to the transmission line's routing, length, and associated area of disturbance. The 40-kV transmission line generally would follow existing and proposed road rights-of-way and parallel areas of disturbance. Cultural resources and sensitive species habitat surveys would be conducted prior to any construction of the proposed transmission line, and standard construction practices would be employed to minimize potential impacts, including the incorporation of standard design features to prevent electrocution of raptors (Subsection 2.1.6.2, beginning on page 54). Further, no construction would occur until appropriate environmental review is complete and necessary permits have been issued.

Standby generators would be required to maintain launch, flight, or landing operations in event of a commercial power failure. Diesel generators would be located at the mission-essential sites (e.g., FOCC, launch/landing complex). Generator enclosures and fuel storage tanks would be designed and installed in full compliance with Federal and State regulations.

Water Supply

Water would be required during all phases of SRS development and operation both for domestic purposes (e.g., lavatories, food preparation, drinking, and fire fighting) and the production of liquid oxygen and liquid hydrogen at the cryogenic fuel plant. Approximately 115 acre-feet per year would be required during construction, and approximately 1,200 acre-feet per year would be required to operate the SRS and the cryogenic fuel plant. (An acre-foot is the amount of water required to cover one acre to a depth of one foot.) Twelve hundred (1,200) acre-feet per year is the normal allocation for irrigation of 400 acres of agricultural land. The annual requirements are summarized in Table 6.

Table 6. Annual Water Requirements by Usage

Usage	Construction	Operations (Treated)	Cryogenic (Treated)
Roads, Building Pad	115 ac ft		
Personnel (500 people @ 35 gal/day)		20 ac ft	
Fire fighting		1 ac ft	
Launch/landing pad coolant		5 ac ft	
Landscape		1 ac ft	
Cryogenic			1,100 ac ft
Miscellaneous		4 ac ft	
Total	115 ac ft	31 ac ft	1,100 ac ft

ac ft — acre-feet

To provide for contingencies, water rights for approximately 2,000 acre-feet would be acquired. These water requirements would be met by local water wells during construction and early operations. Surface water supplies from Elephant Butte Reservoir near Truth or Consequences would supply water for the cryogenic fuel plant. As shown in Figure 9, page 48, water from both sources would be transported via pipelines to a water treatment plant near the FOCC. Placement of water pipelines typically affects a 5-foot-wide strip of land with minor disturbance in a 12-foot wide corridor.

The use of all surface and underground water in New Mexico is governed by the twin legal doctrines of "prior appropriation" for "beneficial use." Under these doctrines, "water rights" are allocated and enforced by the State Engineer and ultimately the courts. All water resources in New Mexico have been appropriated for beneficial use. At present, both surface water and groundwater supplies are over allocated. However, water rights can be purchased, exchanged, or acquired by other means. Thus, water for SRS purposes would be made available only if water rights were acquired and present water users were not adversely affected. To the extent practicable, this EIS will address the configuration of the water distribution system that would be developed to serve SRS needs. Construction would not commence until appropriate environmental review had been complete and applicable permits had been issued. Well fields would be developed to serve as additional underground sources of water to supplement or replace the source from Elephant Butte Reservoir.

Water with total dissolved solids of 300 parts per million or less would be required for cryogenic fuel production (Moore 1996). Water treatment would be necessary under almost any demand/supply scenario. Several criteria must be considered when choosing the appropriate type of water treatment and water-treatment plant location. The largest demand would come from the cryogenic fuel plant, and the need for high quality water suggests reverse osmosis (RO) treatment. RO is often the most cost effective treatment for water with high total dissolved solids.

RO treatment produces a stream of concentrate. Concentrate with high total dissolved solids would not be allowed to accumulate in low-lying areas or migrate to groundwater. These dissolved solids consist of the mineral salts that are naturally present in the water. Even though these salts have been concentrated, the water still may be suitable for many uses. Four methods of disposal that would be evaluated for discharge of concentrate from potable water treatment units are

- Use of deep injection wells. Required underground injection control permits would be obtained (Section 6.0, beginning on page 315).
- Application of concentrate to the ground surface over large areas. This method would provide a constant supply of water for dust control on internal roads and parking areas, as well as for

deluge water at the launch facilities. National Pollutant Discharge Elimination System (NPDES) permits would be obtained where appropriate (Section 6.0, beginning on page 315).

- If Elephant Butte Reservoir were the water source, and if treatment were performed at the reservoir, concentrate with higher levels of total dissolved solids would be discharged back into the reservoir without major impact. The return flow still would be classified as potable water under the Safe Drinking Water Act and would not exceed the State regulatory threshold. An NPDES permit would be obtained if required by the EPA.
- Use of lined surface evaporation ponds to further concentrate the solids for eventual disposal as solid waste. These ponds would be covered to minimize impacts on wildlife.

If an on-site treatment plant were to be necessary, the best location would be near the FOCC where there would be adequate electrical power. The water distribution system would be placed in the proposed road rights-of-way, which would already be cleared and disturbed. The FOCC area provides the closest practical access to Prisor Hill where a 500,000 gallon (65 feet in diameter × 20 feet high) storage tank would be located. The tank would be located in a depression of Prisor Hill to minimize visual impact. The requirement to treat all water, except that used for construction and dust control, dictates that all sources be connected to a single treatment system.

Propane/Natural Gas

During the early stages of SRS development, propane, stored in above-ground tanks, would be used along with electricity to provide space heating, hot water, fuel for cooking, and similar needs. New Mexico storage tank permit requirements are listed in Table 56, beginning on page 316. However, a natural gas pipeline would be constructed to meet long-term needs. The cryogenic fuel plant would be the major user. An estimated 20 miles of underground gas main would be required to transport natural gas to the SRS and distribute it to SRS facilities. Installation of the pipeline typically would disturb a strip of land 5 feet wide, with minor disturbance in a corridor up to 12 feet wide. The line generally would follow existing and proposed road rights-of-way, minimizing areas of new disturbance. The same procedures and standard construction practices proposed for construction of the electrical transmission line would be employed to minimize impacts on cultural resources and any sensitive species habitat. For the purposes of the analysis of cumulative environmental impacts in Subsection 4.12, beginning on page 293, conservative assumptions have been used. As with the proposed electric transmission line, no construction of the proposed natural gas pipeline would be undertaken until the appropriate environmental documentation including NEPA documents and permits were prepared and approved.

Solid Waste Disposal

Solid waste would be placed in metal dumpsters that are animal-proof to prevent scavenging. The dumpsters would be collected on a regular basis and transported to a regional landfill, probably the Las Cruces Regional Landfill approximately 15 miles west of Las Cruces, New Mexico. This landfill opened in 1996. According to officials as quoted in the *Las Cruces Sun-New*, October 20, 1996, the capacity of this landfill should sustain Las Cruces for 680 years at a rate of 175 tons per week. It is unlikely that the SRS would generate more than 7 tons per week or the equivalent of about one truck of solid waste. At this rate, the capacity of the Las Cruces landfill would not be appreciably affected by the SRS. Solid wastes would be recycled whenever possible to minimize the amount of waste sent to the landfill. Examples of wastes to be recycled are office paper, laser printer toner cartridges, and cardboard packing containers.

Hazardous Waste Disposal

The SRS would as much as possible minimize the use of materials and operations that would generate hazardous waste. However, a small amount of hazardous waste would be generated from administrative, facility maintenance, and vehicle maintenance operations. This waste would consist of cleaning solvents, paints, adhesives, and coatings and would be segregated and accumulated in a specially designated area. The accumulation area would have an impervious surface that would be diked, with sidewalls adequate to safely hold all contents plus rainfall in accordance with EPA regulations. An EPA or State Resource Conservation and Recovery Act (RCRA)-permitted hazardous disposal service would be retained to remove and transport the waste to a RCRA-permitted treatment, storage, and disposal facility.

The State of New Mexico Environment Department (NMED) regulates facilities that generate hazardous waste. The amount of waste expected to be generated would classify SRS as a Conditionally Exempt Small Quantity Generator under the NMED *Hazardous Waste Management Regulations*. This class of waste generator produces less than 100 kilograms of hazardous waste per month, less than 1 kilogram of acutely hazardous waste per month, and accumulates less than 1,000 kilograms of hazardous waste. This class of generator is exempt only from registering with the State of New Mexico as a generator and some of the annual reporting requirements.

Sanitary Sewers and Wastewater Treatment

The SRS would require sanitary facilities at each work area. The design of the sanitary facilities should accommodate projected growth, and each level of design would contribute to future increase in demand. At a minimum, a portable, pump-out toilet and hand-washing facility would be required. At more populated areas, a running water system with flush toilets and lavatories would be required. During construction and initial operations, septic tanks and leach fields at individual sites would be adequate.

This system would have the advantage of providing initial treatment in septic tanks. If a central treatment plant were constructed later, effluent would be pumped to that facility. Wastewater disposal methods would depend upon the level of treatment achieved in the treatment plant. If the wastewater were of sufficient quality and disinfected, it would be suitable for landscape and launch/landing complex coolant (deluge water). If this treatment option, and its associated distribution system, should prove too expensive, evaporation ponds would provide adequate disposal. Installation of a wastewater wetland and use of the water for nonpotable needs is another alternative that will be evaluated.

Depending on the method of wastewater disposal, a National Pollutant Discharge Elimination System permit and/or underground injection control permit would be required (Section 6.0, beginning on page 315). NMED requires that a Notice of Intent be filed prior to activity taking place involving the discharge of liquids. In addition, NMED requires submittal and approval of plans and specifications prior to the commencement of construction of sanitary sewage systems, including septic systems. As a condition of the permit, periodic monitoring may be required. Discharge of cooling water at the launch/landing complex and cryogenic fuel plant also would be included in a discharge permit application.

Other Support Facilities

In addition to electrical power, water supply, propane or natural gas, waste disposal, and sewage wastewater treatment, other support services would be required. These would include security, medical services, food services, concessions, and general maintenance. These are not discussed in detail because the environmental impacts would be inconsequential.

2.1.6.8 Cryogenic Fuel Production and Storage

RLVs require cryogenic fuels and high- and low-pressure gases. Cryogenic liquids, specifically liquid hydrogen (LH_2) and liquid oxygen (LOX), would be the primary propellants. Liquid nitrogen (LN_2) would be needed for refrigerant and payload/vehicle processing. Gases would be required for a variety of uses including vehicle and payload processing. These would include gaseous hydrogen (GH_2), gaseous oxygen (GOX), gaseous nitrogen (GN_2), and gaseous helium (GHe). Helium would not be produced on site but would be purchased and stored. Table 7 summarizes the requirements for full operations. Storage requirements would be the approximate requirements for each launch.

Table 7. Cryogenic Fuels and Gases

Item	Use	Source	Storage Requirement
LOX	Propellant oxidizer	Manufactured on site	350,000 gallons
GOX	Gas purge	Manufactured on site; use a vaporizer to convert LOX to GOX	2,500 SCF @ 6,000 psi
LH_2	Main engine propellant	Manufactured on site	925,000 gallons
GH_2	Gas purge	Manufactured on site; use a vaporizer to convert LH_2 to GH_2	200,000 SCF @ 6,000 psi
LN_2	Refrigerant, payload and vehicle processing	Manufactured on site; by-product of LOX process	100,000 gallons
GN_2	Gas purge, payload and vehicle processing, gas purge	Manufactured on site; use a vaporizer to convert LN_2 to GN_2	200,000 SCF @ 3,500 psi
GHe	Gas purge, payload and vehicle processing	Shipped in "tube trailers;" stored in high-pressure vessels	5,000 SCF @ 2,600 psi & 100,000 SCF @ 1,000 psi

SCF — standard cubic feet
@ — at
psi — pounds per square inch

In the early stages of development (e.g., if SRS operations start with only vehicle testing), the quantities of liquid oxygen and liquid hydrogen needed would be small enough to be handled by portable systems. The liquid propellants would be transported to the SRS by tanker truck and stored in tanks situated a safe distance from the launch facilities. The quantity of propellant required would be delivered to the launch vehicle immediately prior to launch. However, as liquid oxygen and liquid hydrogen needs increase, a cryogenic fuel production and storage facility would be required.

Special handling is required for all cryogenic materials. Liquid oxygen strongly supports combustion and—when exposed to ambient temperature conditions—turns into a cold vapor that hugs the ground.

Liquid hydrogen is flammable and produces explosive vapor that is much lighter than air and quickly rises in open spaces. Vapor from liquid nitrogen is an asphyxiant. All cryogenic liquids pose a hazard in that they will freeze skin on contact, with damage similar to a severe burn. Piping and equipment would be specially insulated and designed to preclude not only explosions but also direct contact. Personal protection equipment and special fire protection precautions would be employed for safety purposes.

Leaks of these materials do not pose a risk of contamination to soil or water, but direct contact must be avoided, and sources of ignition must be kept away. Hydrogen gas, especially in the presence of pure oxygen, does present a potential explosion hazard in a confined space. By following standard construction practices for such facilities, the SRS fuel plant would be designed to minimize the potential for explosive accumulation and mixing of hydrogen and oxygen. Although numerous hydrogen and oxygen plants are in operation throughout the U.S., accidents are extremely rare (Air Products, pers. comm., 1995).

The cryogenic fuel plant would manufacture liquid hydrogen and liquid oxygen to fuel the vehicles. Liquefaction of a gas is achieved by first compressing it to high pressure, allowing it to cool, and then expanding it under controlled conditions. Sufficient cooling is achieved during expansion to liquefy part of the gas.

Liquid oxygen would be manufactured by a process called air separation. Air would be liquefied and separated into its components through distillation. Oxygen would be purified and stored. Most of the remaining liquefied gases would be used for refrigeration in the hydrogen production process. Part of the liquid nitrogen would be stored for other uses at the SRS.

Gaseous hydrogen would be produced through a process called steam reforming. In the presence of a catalyst, steam obtained from a boiler would react with methane derived from natural gas to produce hydrogen gas and carbon dioxide gas. The hydrogen would be purified and liquefied by a compression-expansion process similar to that used for air. Because liquid hydrogen is even colder than liquid oxygen or nitrogen, using the liquid nitrogen by-product from oxygen production as a supplemental refrigerant would improve the efficiency of the process.

The processes would be collocated in order to take advantage of similar refrigeration requirements. Figure 12 is block diagram of the liquid oxygen and liquid hydrogen production processes.

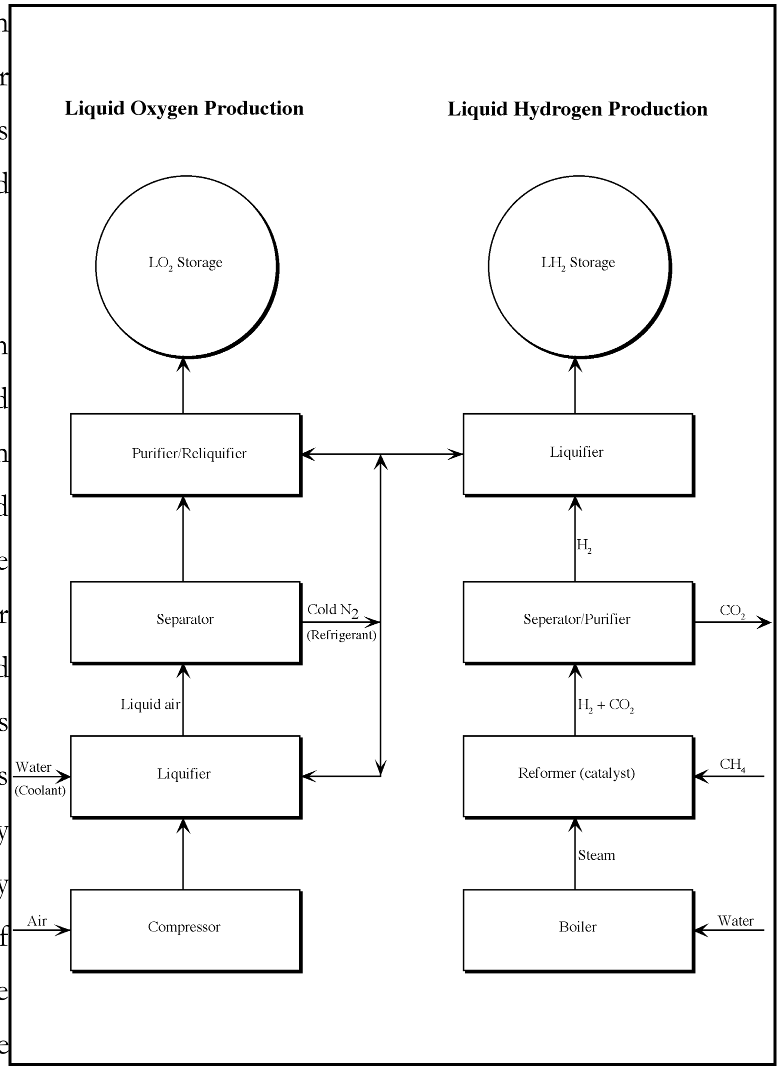

Figure 12. Cryogenic Fuel Production Processes

Production of oxygen and nitrogen requires two primary inputs, air and electricity. The input to the hydrogen process includes natural gas, water, and electricity. Consumption of these resources was based on one launch per week requiring 175,000 gallons of liquid oxygen (833 tons) and 462,500 gallons of liquid hydrogen (137 tons). This would require a liquid oxygen facility capable of producing 167 tons per day and a liquid hydrogen facility capable of producing 27 tons per day. The resultant resource consumption by the cryogenic fuel plant would be

- water – 1,100 acre-feet/year (approximately 1,000,000 gallons/day)
- natural gas – 5,000,000 standard cubic feet per day
- electricity – 700,000 kilowatt hours per day

Water used for cryogenic production could require treatment to reduce suspended and dissolved solids. The hydrogen plant would emit carbon monoxide and nitrogen oxides. Emissions data from existing plants and dispersion modelling suggest that the plant probably would not require a permit under current New Mexico air quality regulations. However, permit requirements can be determined with certainty only after the plant is designed.

The production facilities would require approximately 20 acres for support facilities, loading/parking lot, buffer areas, and storage equipment. Fuel storage facilities at each launch/landing pad would occupy approximately 5 acres. The sites would be covered with gravel to reduce maintenance. Most piping would be above ground for ready access.

Distances between the launch area, fuel production plant, and fuel storage vessels would be dictated by safety considerations and operational requirements. A discussion of explosive yield of cryogenic fuels and personnel safety requirements is given in Subsection 4.1.1.2, beginning on page 178. In selecting a site for the fuel production and storage facilities, the primary safety concern would be the launch area, not personnel safety. If the fuel production and storage facilities were incorrectly sited, there would be the probability of damage and the possibility of a secondary explosion in the event of a launch explosion. The cryogenic fuel plant would be located at least 2,000 feet from the launch/landing complex. Storage facilities would be located at least 1,500 feet from the cryogenic fuel plant. The storage facilities would be located as close to the launch areas as possible, approximately 400 feet.

Using information in U.S. Army DARCOM Regulation 385-100 (DA 1981), the separation distance necessary to prevent detonation between a fully fueled launch vehicle and another quantity of explosive material would be 1,320 feet, assuming 20% explosive yield as discussed in Subsection 4.1.1.2, beginning on page 178. The fuel production plant would be well outside that distance; however, the storage vessels would be within that distance because of the requirement for very high flow rates during fueling. These vessels would contain only minimal quantities of residual fuels at the completion of fueling and would not represent a hazard for a large secondary explosion, but they could be damaged in the event of a launch pad explosion. In addition, the separation between the fuel production plant and storage vessels would be sufficient to prevent a secondary explosion.

The liquid hydrogen storage tank would be a spherical vessel approximately 65 feet in diameter. The liquid oxygen tank would be a cylindrical or spherical vessel approximately 50 feet in diameter. Both vessels would be elevated slightly above ground to provide gravity flow but would be painted in colors selected to blend with the background.

Special foundations would be required for processing equipment to eliminate freezing of groundwater causing frost heave leading to undue stresses on piping and equipment. This would require that cryogenic tanks be elevated. All loading pads would be constructed of concrete, not asphalt. Oxygen will support combustion of asphalt. Thirty months would be required for planning, design, procurement, construction, and commissioning of the plant.

Cryogenic manufacturing plants can start up and be shut down with relative ease. Restarts could take anywhere from two to four hours with a single technician. The plant would be set up so that it could be either unmanned or staffed with one or two operators. A remote operating system would be installed. Typically, only a computer would be required.

Cryogenic fuel plant safety, as with the entire SRS, would consist of a multilayered approach that would entail reviews and approvals. Items that would be considered include

- design
- material selection and testing
- operating and emergency response procedures, training, and equipment
- quantity-distance criteria (to avoid propagation of accidents)
- detection systems (e.g., fires and leaks)

2.1.7 DECOMMISSIONING AND SITE RESTORATION

There are no current plans for ceasing operations of nor decommissioning the proposed SRS; the life of the facility would be indefinite. However, if activities and operations at the SRS were to cease, a comprehensive plan for decommissioning and site restoration would be implemented. While formulation of such a plan is premature, it would include at least these elements

- A plan for dismantling all buildings and other structures as appropriate for either recycling or disposal at a disposal facility approved by NMOSC (or its successors) and the appropriate local jurisdictions.
- A plan for decontaminating any facilities or materials that may have become contaminated with hazardous substances during SRS operations. Decontamination procedures would comply with Federal and State requirements in effect at the time.
- A plan for reclaiming the site involving any necessary recontouring and revegetation using plant species indigenous to the area that would not require continued irrigation
- A plan for future land use including continuation of livestock grazing, other agricultural uses, and outdoor recreation.

2.2 ALTERNATIVES

This section describes a range of alternatives to the proposed action as required by the CEQ regulations (40 CFR §1502.14). The alternatives analyzed in detail include no action and providing the SRS with only a minimal, bare-bones infrastructure. Alternatives eliminated from detailed analysis, and the reasons for their elimination, also are briefly discussed.

2.2.1 NO ACTION ALTERNATIVE

Under this alternative, the SRS would not be constructed nor operated at the proposed site between Truth or Consequences and Las Cruces, New Mexico. Current land uses, principally livestock grazing and outdoor recreation, would continue indefinitely. Management of approximately 189,000 acres of Federal public land would remain under the jurisdiction of the BLM and be subject to existing BLM Resource Management Plans (RMPs). Some mineral extraction could possibly occur on the 27 sections of land that would otherwise be occupied exclusively by the proposed SRS. Cultural resources on land that would otherwise be occupied by the proposed SRS would not be subject to the special protection proposed in this EIS for the other two alternatives.

2.2.2 MINIMAL SRS INFRASTRUCTURE ALTERNATIVE

This alternative is reasonable from a practical, technical, and economic point of view. It represents a conservative approach to developing the proposed SRS pending commitments from enough viable RLV commercial users to justify the significant expenditures necessary to complete a permanent infrastructure for a commercial spaceport (Subsection 1.1.3, beginning on page 5).

Under this alternative, construction of SRS facilities would be kept to a bare-bones minimum. Trailers or temporary modular structures would be used for the SCCF, the M&I facility, the FOCC, fire protection and security, storage areas, and the railroad terminus. While the "footprint" for these temporary structures would be approximately the same as for permanent structures, less clearing, grading, and soil removal would be required. On-site portable diesel electrical generators would replace the proposed 18.5-mile, 40-kV transmission line from Rincon to the SCCF. An on-site cryogenic fuel plant would not be constructed. Instead, space vehicle fuel would be transported by truck from distant locations. Without the cryogenic fuel plant, there would be no need for a natural gas pipeline and its associated land disturbance. Heating and cooking fuels would be supplied by propane delivered to the site.

Further, under this alternative, water would be supplied from deep on-site domestic wells with water treatment being accomplished by a small treatment plant centrally located in the operations area, or by small filtration units located at individual facilities. Surface water from Elephant Butte Reservoir would not be piped to the SRS site. Only the main access road would be paved and gravel would be used as much as possible for all surfacing of internal roads. A paved runway for the airfield and concrete launch/landing pads would still be required.

Although this alternative would meet short-term needs of the proposed SRS operations, the temporary elements of the infrastructure would eventually have to be replaced with permanent facilities.

2.2.3 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY

CEQ regulations require the identification of all reasonable alternatives, and a discussion of those alternatives considered but eliminated from detailed impact analysis (40 CFR §1502.14[a]). A brief explanation is provided as to why these alternatives were eliminated.

2.2.3.1 Spaceport Sites Outside of New Mexico

As discussed in Subsection 2.1.3, beginning on page 26, NMSU (1995) considered alternative spaceport locations in California, Nevada, Arizona, western Texas, and northern Mexico. These locations did not meet one or more siting criteria such as land availability, orbital insertion physics, or access to airspace. Southern California locations—considered in other studies—are too close to major population centers. Further, the underlying need for the proposed SRS, as discussed in Subsection 1.2, beginning on page 6, is to establish an inland spaceport in New Mexico that would be used for scientific and industrial missions while enhancing economic development opportunities associated with aerospace activities. Establishing a commercial spaceport outside New Mexico would not meet this underlying need. This EIS was commissioned as an integral part of the licensing process by the State of New Mexico. The project has been authorized by the State Legislature and funded through appropriation from New Mexico State general tax revenues. It would not be a reasonable nor prudent use of New Mexico appropriated funds to devote them to detailed studies of spaceport sites outside of the State.

2.2.3.2 Other Spaceport Sites in New Mexico

As discussed in Section 2.1.3, beginning on page 26, and Appendix C, the NASA Grant feasibility study (NMSU 1995) and the USAF Grant I study (NM 1995a) focused on the technical feasibility of establishing a spaceport at any specific location only in broad, general terms. The NASA study looked at potential sites primarily in terms of ballistic reentry feasibility. Orbital insertion physics and population density were additional initial considerations. Consequently, the general sites identified in the process of the NASA study were relatively large areas, approximately 166,000 square miles. Sites within New Mexico were identified in the areas of WSMR, Roswell, Tucumcari, and Carlsbad. The WSMR area was evaluated to be the most suitable location, and was the only one discussed in detail in the report (NMSU 1995). Table 1 (page 5) in Appendix C, provides an additional matrix of siting data derived from the NASA Grant study team report.

The USAF Grant I study team started with the contractual mandate to study a dual-use space facility with "dual use" meaning joint military and civilian uses. As WSMR is New Mexico's only existing military facility engaged in space-related missile flight activities, the juxtaposition of the conceptual Grant I study facilities with existing WSMR facilities provided the logical departure point for the study siting process. This assumption was reenforced through cross-pollination with the NASA study. The considerations of orbital physics favoring easterly launches and the existence of already established special-use airspace reserved for missile and space-related research and development further refined the focus of the Grant I study to the area adjacent to the western flank of WSMR. The Grant I study site selection process is discussed in Appendix C, Section 3.1, beginning on page 8. Appendix C contains a detailed discussion of the evaluation criteria used by the study team as well as the parametric and subjective results of the study findings. The general area determined by the Grant I study as the most technically favorable for the location of a dual-use space facility was in the south-central Jornada del Muerto. All of the sites located in this area are relatively equal in terms of technical suitability. This conclusion was separately validated by the GTEC report (NM 1995b). In the scoping process for this document, a specific site within the area was chosen as the location for the proposed action alternative based on the additional consideration of the availability of State Trust Land, and other engineering factors such as the relation of facilities to the existing floodplain.

During the EIS scoping process, the other three New Mexico sites discussed in the NASA study, as well as a wide range of other New Mexico locations, were evaluated as possible alternatives to the proposed action. These locations were examined according to the major criteria used by the Grant I study team (Appendix F), which were

- Flight corridors that meet DOT regulations
- Availability of suitable land for SRS operations
- Availability of land to meet public safety requirements
- Availability of access to controlled special-use airspace

These scoping criteria were applied by the scoping team generally as discussed in the following paragraphs.

The physics of sending a vehicle into orbit are discussed in Section 2.1.3, beginning on page 26. The general launch azimuths for the most probable commercial uses of RLV services from the SRS are shown in Figure 13. These probable, principal, near-term launch azimuths were used in conjunction with population density to determine general launch site areas that could provide flight corridors meeting then current (1995)—and reasonably anticipated future—DOT regulatory requirements. However, the final evaluation of risk to the public for any specific flight corridor originating from the SRS can only be defined after the completion of safety studies based on the actual design of the RLV system that will be operated from the SRS. For scoping of this EIS, it has been determined that the probable primary launch azimuth corridors from potential alternate sites would not pass over major metropolitan areas. The population centers considered are shown in Table 8.

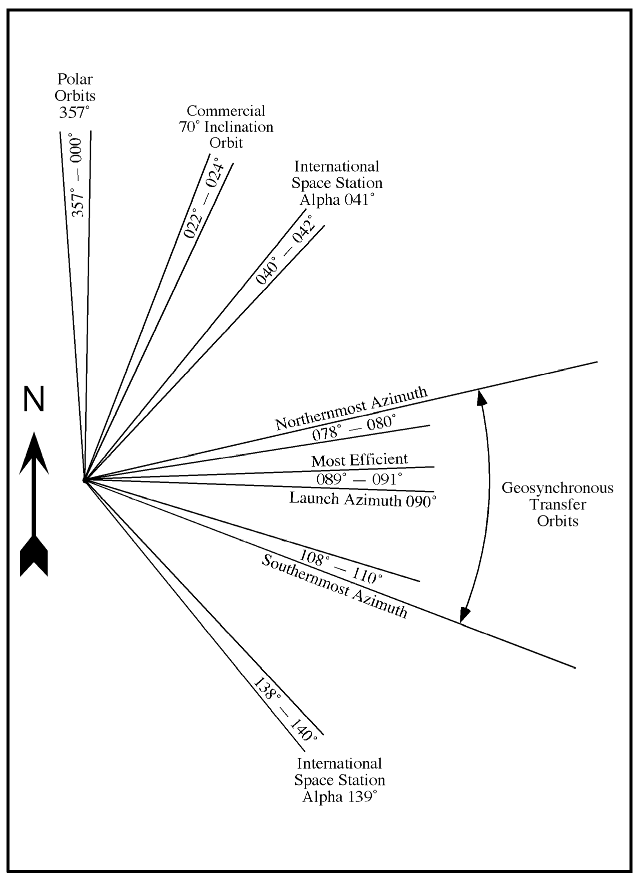

Figure 13. Most Probable Commercial RLV Launch Azimuths

In reviewing potential alternate locations, a launch azimuth for geosynchronous transfer

Table 8. Population Centers

New Mexico	Texas	Oklahoma	Kansas	Colorado
Albuquerque	Dallas/Fort Worth	Oklahoma City	Wichita	Denver
Las Cruces	Waco	Tulsa	Kansas City	
Santa Fe	Houston		Topeka	
Clovis/Portales	Austin			
Hobbs/Lovington	San Antonio			
Carlsbad	Corpus Christi			
Roswell	El Paso			
	Midland/Odessa			
	Abilene			
	Lubbock			
	Amarillo			

orbit or International Space Station Alpha that crossed over a "distant" city (eastern Texas, Oklahoma, and Kansas) did not automatically disqualify a site because an alternate launch corridor would be available for these missions. However, no allowances were made for any probable principal launch azimuth corridor crossing over "close-in" cities (New Mexico, western Texas, and Colorado).

The criterion of the availability of suitable land included the type of land ownership and general topographical conditions. The hierarchy of land ownership was New Mexico State Trust Land, BLM-administered Federal land, private land, and other types of Federal/State land reservations, such as Native American reservations. Consideration of land ownership entailed attention to the people who would be displaced or relocated by acquisition of private land. As discussed in Section 3.8, beginning on page 140, private land ownership within the proposed SRS currently includes only 13 individuals or corporate entities. Fewer than 20 people are permanent residents within the SRS boundaries, and initially not all people currently residing with the proposes SRS boundaries may be required to relocate ("Acquisition of Private Land" beginning on page 53). The requirement to relocate 20 people was used as the benchmark for evaluation of other New Mexico sites. Topographical conditions considered to be the minimum requirement were that the area had to be generally equivalent to the size and uniform flatness of the proposed action site.

The availability of land to meet public safety requirements includes the availability of flight corridors and launch azimuths discussed previously, and other potential clearance requirements associated with a launch or recovery of a space vehicle. These other requirements included control and closure of Interstate highways, major roads, and major transcontinental railroads, and potential requirements for access and control of people residing or working outside of the proposed SRS boundaries. To evaluate sites for overall public safety considerations, a general comparison with existing WSMR conditions was considered applicable. Through a Memorandum of Agreement that is under negotiation with WSMR, through integrated scheduling and operations, WSMR would exercise control of personnel access and activities under potential launch corridors within the WSMR controlled area during SRS operations. This control would extend to approximately 50 miles downrange from the proposed launch point for the arc of potential launch azimuths shown in Figure 13 on page 83. Therefore, a 50-mile radius arc in the eastern semicircle encompassing the range of potential primary launch azimuths was used as a scoping criterion. Within this area, it was considered that SRS launch activities could require control over personnel activities that would have the potential to be significantly disruptive. There are fewer than 20 people who are permanent residents of the eastern semicircle, and it is contiguous with WSMR. This number of people also was used as the benchmark to evaluate other New Mexico sites for disruption of personnel activities. In application of this benchmark, the 50-mile safety arc for the semicircular range of launch azimuths could not extend past concentrations of population in the small eastern New Mexico cities and villages such as Hobbs, Tatum, and Vaughn. Additional applications of the 50-mile arc were used to estimate the number of people who potentially would experience disruptions caused by SRS launch operations. These estimates were compared against those from the proposed location to evaluate the reasonableness of the alternate site location.

Finally, other sites in New Mexico were evaluated in scoping with regard to the availability of existing controlled special-use airspace, the potential realignment of special-use airspace, and the potential disruption of normal civil and commercial air traffic on major east-west airways. The same ground area used to evaluate general overall public safety requirements, approximately 3,120 square miles, was extended vertically to determine potential airspace requirements.

The general area identified in the vicinity of Tucumcari, New Mexico, consisted of an area of topographically suitable land in southwestern Quay County. This site also provided satisfactory access to orbit using the primary launch azimuths. Easterly and southeasterly azimuths would pass between the more populated areas around Clovis and Portales but would fly near Cannon Air Force Base. The land in the area is totally privately owned; therefore, as many as 1,000 people potentially could be displaced by the land acquisition process. In addition, as many as 5,500 people potentially live within the 50-mile easterly semicircle defined by the projected principal launch azimuths.

The site in the vicinity of Roswell, New Mexico, was an area in east-southeastern Chavez County. The primary launch azimuths could be adjusted to provide safe separation for the Clovis/Portales and Hobbs/Lovington areas; however, downrange conflicts exist with all western Texas cities. As many as 500 people could be displaced by acquisition of private land at this location, and as many as 9,000 people potentially live within the 50-mile easterly semicircle defined by the projected principal launch azimuths. This location also poses potential interference problems with a major commercial airway serving the Dallas/Fort Worth area.

The general vicinity of Carlsbad was evaluated by the NASA study in terms of ballistic reentry recovery sites. Subsequent scoping in terms of the full range of potential primary launch azimuths for RLVs from the SRS shows a significant reduction in available corridors due to both distant and close-in population centers. In addition, potential spatial conflicts are possible with the Department of Energy's low-level radioactive waste repository at the Waste Isolation Pilot Plant located northeast of Carlsbad.

The preponderance of mountainous terrain, lack of available launch azimuth corridors, and location of National Forest and Native American lands eliminated the vast majority of additional land areas in the State as potential SRS locations. However, additional topographically suitable sites were examined in the eastern portion of the State and in the south-central portion west of Las Cruces. Potential locations in Luna, Grant and Hidalgo Counties are limited by lack of available launch azimuth corridors. In addition, use of these sites would require frequent closure of the major Southern Pacific railroad route between Los Angeles and El Paso and Interstate 10, which has been evaluated as a public safety issue by the New Mexico State Police (Appendix B).

A potential site in southeastern DeBaca County, at the Chavez County line, was found to have suitable topographical characteristics and availability of primary launch azimuths. However, this site would displace as many as 700 people in the SRS land acquisition process, and as many as 8,250 people potentially live within the 50-mile easterly semicircle defined by the projected principal launch azimuths.

For the reasons discussed above, other potential locations in New Mexico were examined but eliminated from detailed study.

2.2.3.3 Alternate Configurations Within the Proposed SRS

Regardless of the siting of the facilities within the proposed SRS boundaries, the size of the facilities and their relative positions essentially would be the same because they are determined by safety and orbital physics considerations. Therefore, the potential environmental impacts associated with alternative configurations would not be substantially different. The distances separating the launch/landing complexes, FOCC, M&I facility, and the logistics airfield cargo handling area are set by safety considerations. The principal environmental and engineering constraint associated with the selected RLV operations and airfield areas is the Jornada Draw, a designated 100-year floodplain exhibiting a high degree of biodiversity and species richness. The proposed SRS configuration was selected to minimize construction in the floodplain.

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